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The Wider Study of Method[1]

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" . . . Just as we need to study the curriculum to find out *what* to teach, so we need to study method to find out *how* to teach. When we come more closely to the question of method we find there are two problems of method: one long recognized, the problem of how best to *learn*—and consequently how best to *teach*—any one thing, as spelling; the other less often consciously studied, the problem of how to treat the learning child, seeing that he is willy-nilly learning not one, but many things all at once, and that we teachers are responsible for all that he learns. The first of these problems we call the narrow view of method; the second, the wider view of method."

"I begin to see what you mean. But why do you say 'narrow' and 'wider'? Do you mean to disparage the one and exalt the other?"

"By no means. The one is narrow because it considers only one thing at a time, the other is broader because it takes into account many learnings all going on at once. But there is no wish or willingness to disparage the narrow view. Some of us think the psychology of learning which undertakes to answer the first problem is the most notable single contribution that psychology has thus far to offer."

"Won't you say a further word about the wider view of method? I don't get exactly what you mean. The idea is so new I don't fully grasp it."

"As it seems to us, any child during an educative experience learns not merely the one thing he is supposed to be engaged in, say a grammar lesson, but is also at the same

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time learning well or ill a multitude of other things. Some of them may be: how he shall study, whether with diligence or the reverse; how he shall regard grammar, whether as an interesting study or no; how he shall feel toward his teacher, whether as friend and helper or as a mere task-master; how he shall regard himself, whether as capable or not; whether or not he shall believe that it pays to try (in such matters as grammar); whether to form opinions for him-self and to weigh arguments in connection; how he shall practically regard government (school, home, wider), whether as alien to him and opposed to his best interests, a mere matter of contrary superior force, or as just and right, inherently demanded, and friendly to his true and proper interests. This by no means exhausts the list, but it will give you some idea of what we have in mind in saying that many things are being learned at once. You will also see how important some of these attendant learnings are, and I believe you will agree with us that whether they are well learned depends in great measure on how the teacher treats the children."

"You are right, I am sure, and I see, too, how important the recitation period is. Isn't this what some people have in mind when they speak of the 'socialized recitation'?"

"Yes, undoubtedly, only I have not seen any attention called in connection with it to this central and underlying fact of many simultaneous learnings. The 'socialized recitation' by its emphasis on the social situation fixes attention upon an important source and matrix of simultaneous learnings. Think how many things go on in a properly conducted recitation and how favorable for learning are the conditions. The conscious presence of others engaged with us on a common problem gives stimulation for thought, furnishes occasion for the exercise of many kinds of social behavior, and provides the critical and approving situation so useful for effectual learning. Yes, the 'socialized recitation' is a noteworthy attack upon the wider problem of method."

"I begin to wonder whether these attendant learnings are not just as valuable as the learning that is generally more immediately in our consciousness. Are not our practical ideals and attitudes built largely in this incidental way? Go back to the grammar lesson. Isn't the boy in just such everyday experiences building his actual ideals, I mean the ideals and

attitudes he actually lives by? Isn't it in this way that he becomes accurate or slovenly in his thinking, efficient or not in attacking problems, courteous or discourteous in his dealings with others, honest or dishonest in doing his work? It begins to seem to me that it is mostly in these concomitant learnings that the important things of life are found rather than in the school subjects as we commonly think of them. What do you say?"

"Before we take that up I think it might help if I introduced some terms I heard at summer school last session. The word concomitant you used just now was one of them. The terms as I got them were primary, associate, and concomitant. The word 'primary' was used to refer to all the learning that belongs closely to the thing immediately under consideration: If I am making a dress, then the primary includes all the learning that comes from the actual making, such as increased skill in planning and cutting. The term 'associate' is usually found in the phrase 'associate suggestions' and refers to all those allied thoughts or ideas that come from working on the dress, but which if followed up then would lead me away from my dressmaking. I may thus be thinking whether the dress will wash, and so think about the dye used, and ask myself how such dyes are prepared. This in its place is a valuable and proper question, but I do not need to answer it in order to make this dress, and if I do try to answer it, I must for the time lay aside my dressmaking. The 'concomitant' learnings grow (in part at least) out of the dressmaking, but do not belong so closely or exclusively to the dress as do the primary. I may thus say, 'I see it pays to be careful'. I learned this, perhaps in connection with making the dress, but it should remain with me as an ideal that will reach beyond dressmaking. In general we may say that the concomitant learnings have to do with more generalized ideals and attitudes, while the primary learning has rather to do with specific knowledges and skills. The concomitant is typically of slower growth, requiring perhaps many successive experiences to fix it permanently in one's character. Prominent among concomitants are personal attitudes, attitudes toward one's teachers or comrades, attitudes toward the several subjects of study (as geography or history), attitudes toward one's self, such as self-reliance or pride or humility.

Other important concomitants are standards of workmanship and the like, neatness, accuracy, or the reverse."

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"It used to be that I was often impatient if my children asked questions suggested by the lesson but not on the lesson. You see my eyes were glued on the course of study, and I thought of these questions only as mind wandering. I still am troubled to keep the class sufficiently intent on the matter at hand, but I feel differently about the outside questions and I act differently. Now I feel that I and my pupils are really succeeding when these associated suggestions arise. Properly used, they mean growth. We don't yield to the present inclination to follow them up, but we do notice them enough to see whither they invite us. Sometimes we write them down for future use. And I see a different attitude is already growing up in the class. They are more thoughtful. Associated suggestions noted in the past come up again in their right places, and James or Mary is proud to have foreseen the point. They feel differently toward me too. We seem to be working more sympathetically, and we really enjoy thinking things out together and connecting them all properly. I find that I respect my pupils more, or really the advance connections they see are remarkable. And they think more connectedly now, instead of less connectedly as I feared. Their organization is much better. You see I was beforetimes repressing rather than encouraging their natural inclinations to think.

"And as for the concomitants, I am now much concerned about them, particularly as to what attitudes are being built and how I can help forward the better ones. I see now that I always valued those things, the ideals and attitudes of my pupils; but I didn't concern myself consciously and specifically about them. I somehow trusted to luck for them. I was a kind of fatalist about them. The pupils who were going to have good ideals were going to have them, and that was all there was about it. I scolded sometimes and criticized a good deal, but I now think that in so doing I did more harm than good. Now I know that each idea and each atttiude has a life-history of its own, each is built up just as truly as is any fact of knowledge or any skill.

"It seems to me that you are now contradicting yourself. Earlier you were speaking of these attitudes as being built

incidentally. Now you talk as if you seek them directly. Which is right?

"So far as the child is concerned they are principally built incidentally, that is, in connection with other purposes of his. I as teacher, however, must be conscious of what he is doing and steer his various activities so that the proper ideals and attitudes shall actually grow up. I seek them directly, he achieves them—for the most part—indirectly. But at times we do talk matters over, because clear consciousness is often an important factor in building ideals."

"I understand you now on that point, but I wish to ask further. Do you then judge each thing the children do under these three heads of primary, associate, and concomitant?

"Typically, yes. Each study period, each recitation period, and each recess is in its own measure going to result in primary learning of some kind well or ill done, in few or many, rich or poor, associated suggestions, in good or bad concomitants. As teacher I am in some measure responsible and in so far I must know what is going on and adequately appraise the results. In the light of the results—so far as I do or could influence them—am I to be judged."

"Isn't it different now? If I understand you aright, we examine and promote almost if not entirely on the primary learning, and disregard the other two."

"Yes, I think we do. You see we can test the primary learning so much more easily than we can the others. The new scientific tests and measures of achievement even reinforce the tendency to pay exclusive attention to the primary, because they are so far for the most part confined to the more mechanical skills and knowledges. I sometimes fear their first effect will be to fasten the merely mechanical side of school work even more firmly on our schools."

"Well, you certainly surprise me now. You have always been eager for each new advance of science, as I have heard you say, and here you are decrying what you must admit is at least one of the most scientific steps yet taken in the study of education. I didn't expect it of you."

"The new tests are indeed a contribution of the very first value, but what I say is still true. So far as they measure achievement they are up to now largely confined to the more mechanical aspects of learning. A superintendent gives a se-

ries of tests in spelling, arithmetic, or reading. Sooner or later the teachers learn the records of their classes, and unless the superintendent is wise they will find themselves rated according to these records. If the superintendent could as satisfactorily measure the teacher's success in building ideals and attitudes, so that all the educational outcomes could be weighed, the situation would be different. But as matters now stand the superintendent is in danger of taking the teacher's attention away from the 'imponderables,' the ideals and attitudes and moral habits that cannot yet be measured in wholesale quantities, and of fastening that attention upon a part only of the educational output and that the most mechanical. This is no fanciful picture, I assure you. The danger is very real. Such considerations as this make me look earnestly for the day when we shall be able to measure the whole gamut of achievement. I believe that day will come and a great day it will be. Till then, however, I should advise superintendents to look carefully how they use the tests. Use them, but with a clear sense of their limitations and dangers. In the meanwhile the greater reason for urging attention to the wider problem of method. We must make everyone see the value of the concomitant learning and of the associated suggestions Every recitation period, every school exercise must be appraised under all three heads of primary, associate, and concomitant.

"If you made your expression even stronger, I should not object. When I consider that while we are stressing arithmetic, for example, our children are forming at the same time the very warp and woof of their moral characters, I shudder to think of the consequences if our teachers see only the arithmetic and ignore the life-attitudes being built. Fortunately, there is no necessary opposition between the two, rather the contrary; but nothing can excuse us for failing to consider those other outcomes that inevitably accompany every school activity."

"The wider problem of method seems to me now to be almost the same as the moral problem of life itself. As I now see it, our schools have in the past chosen from the whole of life certain intellectualistic tools (skills and knowledges), arranged these under the heads of reading, writing, arithmetic, geography, and the like, and have taught these separately

as if they would, when once acquired, recombine into the worthy life. This now seems to me to be very far from sufficient. Not only do these things not make up the whole of life; but we have so fixed attention upon the separate teaching of these as at times to starve the weightier matters of life and character. The only way to learn to live well is to practice living well. Our highly artificial study of arithmetic and geography and physics has too often meant that the child lived but meagerly in and through the school studies. The practice of living that has in fact counted most for him has too often been what he and his like-starved fellows could contrive for themselves apart from their elders. Educative indeed has this been, but not always wisely so. There is no cause for wonder that American citizenship disappoints. Democracy demands a high type of character. Our schools have not risen to the demand upon them."

"Do you mean that the wider problem of method especially concerns building for citizenship?"

"That is exactly what I mean. It has always been so. Without clearly distinguishing what they did, or rather how the results have been attained, each long-abiding type or ideal of civilization has contrived its answer to this wider problem of method in such fashion as to mold the type of character correlatively needed to perpetuate itself. The Spartan and the Athenian of antiquity differed from each other quite as much by reason of different methods of education as because of the different contents of the curriculum. The proverbial "hardening" of the former was sign and result of the treatment accorded their youth. The slave of every age has by well-contrived processes been made lowly in spirit the more contentedly to bear his hard lot and lowly station. Civilizations have differed much as to whether the individual man should think for himself: those opposed to such thinking have always contrived such methods of treating their young as early habituated them to acquiescence in the officially approved opinions. Prussia, old China, Mahomet, the Jesuits, the older military discipline, all represent various efforts along this line. These have differed among themselves almost *in toto* as to the primary learning they have sought to inculcate; but they have been agreed markedly in the methods of inculcating the concomitants, the desired attitudes.

"We then in this country must study anew the (wider) problem of method in order the more adequately to devise the proper treatment of our young so as to fit them for democratic citizenship. The beginning of this wisdom, I believe, is to recognize the fact that the child learns many things at once. On this rock of simultaneous learnings shall we by proper effort rear the needed structure of an all-round character."

A Course in General Science for Vocational Home Economics Schools

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FOREWORD

The content of the related science courses in vocational home economics program of day schools is a problem of such vital importance that it must be solved before the successful establishment of this particular phase of vocational education can be accomplished. When there is some understanding of what science is fundamental in the best possible management of a home, the method of presenting this material may be determined readily on the basis of the generally accepted principles of the teaching process.

The science related to the home can be discovered only by a careful analysis of each duty in the processes of housekeeping and of homemaking. The analyses can be prepared only by persons experienced in the performance of the duties they are analyzing, after which the analyses should be revised as a result of discussion by a group of people familiar with both the practice and the science of homemaking.

Such analyses will in reality become the directions for doing the work. These directions should contain not only a list of all operations which are encountered in the performance of a household duty, but should contain also the objective of each principal operation thus listed, and a detailed description of how each operation should be performed. The related science as well as the related mathematics and art will be found in these detailed descriptions.

This plan of analysis has been introduced into the industries

by L. A. Hartley, State Supervisor of Trade and Industrial Education. Analyses prepared by this method are now in use in a number of nationally known business organizations. The method is discussed in Trade and Industrial Series Nos. 26 and 27 issued by the State Office and in Mr. Hartley's text, Foreman Training and Factory Management.

The home economics section of this State Office will issue in the near future a bulletin in which this method of analysis will be adapted to use of teachers of homemaking in evening and in day schools.

This kind of analysis or of directions for performing work is distinct from certain kinds of analysis found in trade and industry and in home economics. It should not be confused with a so-called analysis which contains a list of jobs to be performed but which omits objectives and directions and therefore omits the definite statement of the related science and art. Neither should it be confused with a list of specific directions for performing duties which directions have been prepared with no consideration of the reasons for each step.

The preparation of analyses containing the directions for accomplishing all the operations listed, their objectives and the science and art involved in this performance is a task of considerable magnitude. It is much better, however, to make a few complete analyses of this kind than to adopt a method of work which will not reveal the related science and other instructional material and which therefore is of little if any value to teachers.

Until such time as the science related to the home can be determined by means of analyses including the objectives, the directions and the reasons for the performance of the principal operations in the work of the home, the teachers of related science courses in day schools will need to depend more or less upon text books. The texts should be selected from those that have been written for the purpose of connecting science instruction with the students' environment. In order to select the material of value to prospective home makers, the teacher, whether man or woman, must necessarily have both a practical knowledge of and an interest in the performance of household duties and an understanding of the relation of science to their performance.

This outline of a course in General Science Related to the

Home was compiled by a group of eight students who composed a special section of the General Science Education Class in the 1921 Summer Session of the University of Nebraska. Miss Ida Carr taught this class under the supervision of Professor Herbert Brownell. Miss Carr was chairman of the committee on Related Science in the Home Economics Section of the Third Annual State Vocational Conference and is now Assistant State Supervisor of Vocational Home Economics.

The preparation of this outline was undertaken at the request of the State Office which greatly appreciate this cooper-nation of the object, the better the result of the photographer's

Introduction

The topics included in this outline are taken from chemistry and physics and are those which seem most pertinent to the needs of the girl in her training for home making. Topics in biology or physiology, which appear in many general science texts, have not been included, since at least one semester of physiology, as such, is offered in all vocational courses in home making in this state. No more material has been included in this outline than may well be accomplished in one semester. If two semesters of general science are given, more topics may be introduced. It is expected that each taecher will adapt the outline to individual conditions.

Among the references listed, those in Lynde's Household Physics, and in Vivian's Household Chemistry, will be found indispensable in giving to the teacher the necessary scientific background for each lesson. The definite page references have been given in a few general science texts in successful use in the state. Other available texts may be used to supplement these. An additional list will be found in the appendix.

Attention is called to the form of the outline, the topical arrangement of subject matter, laboratory and text references, suggestive questions and applications. It is urged that the experimental method of presenting subject matter be the "back bone" of the course. It is essential that the student have a clear understanding of the scientific principles involved before attention is directed to their applications. This understanding can only come thru well planned laboratory work. There is a real danger of making the work "top heavy" as to these applications. It is not desirable that all those listed be presented in the class. The wise teacher will select a very few, and develop

these in an interesting way, leaving the student with an open mind, eager to discover other applications for herself. (See appendix A for type outline of an application from which a project may be developed).

Successful teaching will be indicated in two ways, first, has the interest of the pupil in science been aroused to the extent that she will continue to be a science student, alive to the world in which she lives; second, does she continue to make intelligent application of science to her everyday problems?

OUTLINE OF COURSE IN GENERAL SCIENCE

I. Oxidation

Definiton: conditions necessary; forms; products; heat, effect on solids, gases, liquids; transmission of heat, radiation, conduction, convection; measurement of heat; conservation; fuels.
Food as body fuel; calorie—unit of measure.

REFERENCES[1]
Laboratory: Br. Man. 9-12
Texts: Br. 16-18; Cl. 50-66, 21-32; S. & W. "Sci. in Home" 175-217; Ly. 79-144; Tr. 3-16; V. S. 21-32, 271-285.

SUGGESTIVE QUESTIONS
1. Why does water put out a fire?
2. Why does striking a match make it burn?
3. Why are cracks made in cement walks?

Kitchen range; fire prevention; fire extinguisher; matches; heating systems, fire place, stove, hot air furnace, steam heater, hot water heater, vacuum steam heater; fireless cooker; thermos bottle; refrigerator; ice cream freezers; clothing, conductors of heat.

II. Atmosphere

Air: properties; uses.
Atmospheric pressure: effect on boiling point; variations; measurement.
Weather and climate: air currents; highs and lows; weather forecasts.
Relation to human activities: necessary adustments, food, clothing.
Moisture in the air: humidity, conditions affecting, effect on comfort; evaporation; condensation; precipitation.
Ventilation: necessity; methods.

REFERENCES
Laboratory: Br. 52-62, 63-77.
Texts: Br. 110-147; Cl. 337-388; C. & E. 1-16, 21-55; H. & W. "Sci. in Home." 40-47, 58-59; H. & W. "Sci. in Community." 68-110; Ly. 49-61; Tr. 17-33; V. & S. 1-66.

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[1]Br.—Brownell
C. & E.—Caldwell & Eikenberry
Cl.—Clark
H. & W.—Hunter & Whitman
Ly.—Lynde
Tr.—Trafton
V. & S.—Van Buskirk & Smith
Vi.—Vivian

SUGGESTIVE QUESTIONS

1. Why will kerosene flow out of can more easily after one has loosened the cap?
2. Why is an air-filled tire harder at noon than in the morning?
3. Why are electric fans a comfort in summer?

APPLICATIONS

Pressure cooker; vacuum cleaner; pumps; barometer; methods of ventilation; interpretation of weather maps.

III. Water

Occurrence.
Chemical composition and properties
Physical properties: Vaporization; condensation; expansion at 4 degrees C.; boiling point, effect of altitude, effect of solution; solvent action; freezing, effect on solution; water pressure.
Osmosis
Capillary attraction.
Purification: tests forimpurity; means of purification, distillation, filters, chemicals.

REFERENCES

Laboratory: Br. 44-46; Ly. 148-151; Vi. 30-33, 41-44.
Text: Br. 85-102; C. & E. 103-136, 154-165; Cl. 318-356; H. & W. Sci. in Home 74-89, 144-156; H. & W. Sci. in Community, Chapters 7 & 9; Ly. 30-47; Tr. 45-58; V. & S. 68-117; Vi. 21-44.

SUGGESTIVE QUESTIONS

1. In case of fire in your town how far can water be thrown?
2. How can water be tested to make sure it is safe for drinking purposes?
3. Which would burn one's hand more severely, boiling water or boiling syrup?

APPLICATION

Home water supply: how obtained, pumps, cistern, springs, pneumatic tank, city system; means of plumbing; ways of storage.

Purification: dangers from impure water; ways of contamination: situation of wells; river water.
Sewage Disposal: earth closets; chemical toilets; cesspools, location, capacity; septic tank; city system, laws regarding.
Home Plumbing: essentials, efficient, sanitary, easily cared for; fixtures; care and repair.
Osmosis: in plant growth: osmosis in plant absorption.
Freezing Mixtures

IV. Common Chemical Reactions

Acids and bases: familiar examples; development of definition; uses; neutralization, examples, solids, uses.
Elements: where found in nature; properties of common element; symbols; importance of those found in body.
Compounds: formation, simple equations.
Distinguished between chemical and physical change.
Chemistry of cleaning: softening of water; removal of stains; action of soap; bleaching; effects of acids on metals.

REFERENCES

Laboratory: Br. 94-100; Vi. 159-160, 277-279, 323, 382-383, 410.
Tests: Br. 173-196; C. & E. 68-69; Cl. 138-173; H. & W. Sci. in Home 232-236; Tr. 114-117; Vi. 97-103, 154-161, 263-280, 317-324, 375-384, 392-399, 404-411.

SUGGESTIVE QUESTIONS

1. Why do we put soda in cream of tomato soup, in griddle cakes?
2. What is meant by the claim "Ivory Soap, 94-100% pure?
3. Why not allow tomatoes to stand in the opened tin can?

APPLICATIONS

Materials for cooking utensils; cleaning of metals; substitutes for commercial baking powder; souring of milk; making of vinegar; home made soap; tests for good soap.

V. Foods

Needs of body.

Food stuffs as source of energy: carbohydrates, fat, protein; chemical compostion; calorie value; tests; effect of cooking, heat, moisture.

Food stuffs as body-building and regulating material, protein; water, minerals, vitamines; importance; where found abundantly.

Balance in diet: acid and base forming foods; amount and kind of food, individual needs.

Care of food in the home.

Cause of food spoiling: bacteria; yeast; molds.

Food preservation: purposes; methods, canning, drying, preservatives, cold storage, storage of vegetables.

Leavening agents: air; steam; carbon dioxide, yeast, baking powder (by products); soda plus acid.

Food substitutes and adulterants: responsibility of government, pure food laws; responsibility of home maker, intelligent marketing.

REFERENCES

Laboratory: Br. 126, 135-137, 152-153; Vi. 286-288, 391.

Text: Br. 219-233; C. & E. 75-77, 336-351, 358-361; Cl. 67-117; H. & W. Sci. in Home 90-129; H. & W. Sci. in Community chaps. XI & XII. Tr. 58-117; V. & S. 164-206; Vi. 263-288, 324-330, 341-391.

SUGGESTIVE QUESTIONS

1. Why not have a food expert make out a year's daily menu for all the families in town?
2. Why do we find few cases of indigestion among Indians living in their natural environment?

APPLICATIONS

Food classes as need arises.

VI. Textiles

Kinds of fibers: uses; properties; comparison of fibers; tests; adulteration.

Dyeing: kinds of dyes; methods; use of mordants.

Laundry: removal of stains; softening of water, temporary hardness, permanent hardness.

Soaps: kinds; manufacture; as cleansers.

REFERENCES

Laboratory: Br. 96-97; Vi. 37, 140-142, 268-269, 397-398.

Texts: Br. 272; Cl. 129-137, 168-172; H. & W. Sci. in Home 219-237; Ly. 111; Proctor & Gamble, Approved Methods of Home Laundry; V. & S. 286-306; Vi. 37, 146, 392-397.

SUGGESTIVE QUESTIONS

1. Why is a pieces of wool hard and stiff after having been washed in hot water with strong soap?

2. Why do your hands become harsh and dry if you use strong soap?
3. Why do clothes sent to the laundry regularly wear out more quickly as a rule than those washed at home?

APPLICATIONS

Mercerization of cotton; home laundry; home dyeing; intelligent choice of fabrics.

VII. Matter and Energy

Matter: properties; changes in.
Energy: mechanical; chemical; electrical
Work as a form of energy.
Resistance to work: friction; inertia; weight.
Machines as savers of energy: lever; pulley; wheel and axle; inclined plane.

REFERENCES

Laboratory: Br. 38-40, 160-167.
Texts: Br. 151-167; C. & E. 165-191; Cl. 289-318; H. & W. Sci. in Home 331-343; Ly. 1-23; V. & S. 307-332.

SUGGESTIVE QUESTIONS

1. Why are chains put on automobile tires for muddy roads?
2. Why do we have a long handle on a clothes wringer rather than a small one as on an egg beater?
3. Why can one go much faster on a bicycle than in using the same amount of energy in walking?

APPLICATIONS

Levers, nut cracker, tack lifter; sweeping; pulleys, dumb waiters; elevator, well; inclined plane, screw, clamp, food chopper; wheel and axle, bread mixer, clothes wringer.
Conservation in work of the home, washing machines, sewing machines, other labor savers.

VIII. Electricity

Sources: simple cell, voltaic, dry cell.
Uses.
Transmission: method; meaning of conductor, insulator, current, resistance, fuse.
Electro-magnet; electric bell.
Household use; economy in use; reading meter.

REFERENCES

Laboratory: Br. 167-172.
Texts: C. & E. 173-236; Cl. 207-235; Br. 168-172, 184-190, 218-219; H. & W. "Sci. in Home" 344-369; H. & W. "Sci. in Community" 346-354; Ly. 161-193; Tr. 151-153, 11-13, 41-44; V. & S. 255-368.

SUGGESTIVE QUESTIONS

1. Why not repair a fuse with a penny?
2. How could a live wire be pulled away from a person suffering from a charge?

APPLICATIONS

Electrical appliances: kinds, irons, fans, washing machines, door bells, incandescent light, sewing machines, stoves, grills, toasters, telegraph, telephone; care and repair.

IX. Light

Source.
Nature.
Transmission: medium; reflection; refraction; diffusion.
Meaning of terms: opaque; translucent; transparent.
Color: spectrum; white and black; color chart; color harmony; colors in relation to light, warm colors, cool colors.

REFERENCES

Laboratory: Br. 172-175, 177-179; V. & S. 249-253.
Text: Br. 336-342; Cl. 240-280; H. & W. Sci. in Home 238-266; H. & W. Sci. in Community 237-246; Ly. 246-273; Tr. 33-44; V. & S. 248-270.

SUGGESTIVE QUESTIONS

1. How may a dark room be made to appear lighter?
2. Why does a blue dress look blue?
3. Why is one warmer in the sunlight if she wears a black dress?

APPLICATIONS

Lighting the home.
Natural lighting: placing of windows; color of walls; finish of walls; furnishings; draperies.
Artificial lighting: candles; kerosene lamp; gas light; electricity.
Color combinations.
Arrangement of working space as to light: avoidance of eyestrain; placing of mirrors; hanging of pictures.

APPENDIX—A

STUDY OUTLINE—REFRIGERATOR

1. Purpose of the refrigerator.
   How does the refrigerator accomplish the purpose for which it is made?
2. Material used:
   (a) Outside walls: Why selected.
   (b) Insulation: Purpose; Influence on efficiency.
   (c) Lining: Materials used; Purpose.
3. Parts of the Refrigerator
   (a) Ice compartment: Location; Why corrugated.
   (b) Shelves: Removable; Made of wire.
   (c) Drain pipe: Trap; How made; Need for cleanliness.
4. Air circulation
   (a) How accomplished: Ice; Air currents.
   (b) Purpose: Effect on cooling; on moisture; on odors.
5. Drainage
   (a) How accomplished
   (b) Drain tube, cleanliness.
6. Conclusion
   1. Refrigerator is able to do its work because of: materials of which made; parts; circulation of air.
   2. Devices which may be substituted for refrigerator. Different kinds of refrigerators.

A variety of projects might be developed from such a study. For instance: "How can the amount of ice used be reduced, without increasing the temperature maintained?" A project in General Science of educational value will be accepted in fulfillment of the requirement that every vocational homemaking student shall complete one project during the year.

APPENDIX—B

REFERENCES

Brownell—*Laboratory Manual of General Science.* Macmillan.
Brownell—*General Science.* Blakiston.
Caldwell and Eikenberry—*General Science.* Ginn & Company.
Clark—*An Introduction to Science.* American Book Co.
Hunter and Whitman—*Civic Science in the Home.*
Hunter and Whitman—*Civic Science in the Community.* American Book Co.
Lynde—*Physics of the Household.* Macmillan.
Proctor & Gamble—*Approved Methods of Home Laundry* (free)
Trafton—*Science of Home and Community.* Macmillan.
VanBuskirk and Smith—*Science of Everyday Life.* Houghton Mifflin.
Vivian—*Household Chemistry.* American Book Company.

SUPPLEMENTARY REFERENCES

Hessler—*First Year in Science.* Lakeside Press.
Barber—*First Course in General Science.* Henry Holt & Company
Smith and Jewett—*Introduction to the Study of Science.* Macmillan.
Elhuff—*General Science.* D. C. Heath Company.
Pease—*First Year Course in General Science.* Merrill Company.
Hodgdon—*Elementary General Science.* Hinds, Hayden and Eldredge.
Washburne—*Common Science.* World Book Company.

Laboratory Work in General Science[1]

HELEN R. HOUCK, Baltimore, Md.

Individual laboratory work in General Science is very desirable, since it gives opportunities for active participation and for actual contact with working materials, which is exceedingly beneficial to pupils. Where individual work is impossible, group experiments are a good substitute. Demonstrations by pupils or by teacher are invaluable for starting discussion. Any general science course should be rich in these. The experiments used should be a vital part of the work and represent a real problem for the pupils. Any good laboratory manual, such as Caldwell, Eikenberry and Glenn, will give the proper type of experiment. The apparatus used should consist of simple materials, which are less expensive than the usual equipment but just as educative.

1 From bulletin "The Teaching of General Science in High Schools." Pub. by Maryland Board of Education.

All the material needed will be found in any physics, chemistry, or biology laboratory.

PRINCIPLES FOR CHOICE OF PROJECTS

1. They should be based on a common human experience and the needs related to them.

2. They should be related to basic industries, the community and the school activities, and the life of the home; and they should extend from these to larger considerations.

3. They should be so graded as to be hard, to call for the pupils' best efforts; and should be increasingly difficult as the pupil develops the power of attack through experience.

4. All projects should be unified under central topics, in progressive order, so that whenever possible the results of one piece of work may find application in another. This problem of organization should be part of the teacher's work.

MINIMUM LABORATORY EQUIPMENT FOR GENERAL SCIENCE

1. Cases for storing apparatus are a necessity They may be home-made, or may be purchased from any reliable school laboratory furniture concern. They should both afford ample room and furnish protection from dust and dirt.
2. A standard laboratory table for General Science is 72x42 inches, and provides for four (4) students It should be solidly and rigidly constructed, and the top should be at least $1\frac{1}{2}$ inches thick. It can be made in the manual training department.
3. If funds are available, there should be as many sets of laboratory apparatus for the students' exercises as there are groups of four (4) in the class—that is, one set for every four (4) pupils.
4. There should be an ample supply of laboratory manuals for the use of the pupils. Manuals are published for most general science text-books.
5. At least 35 exercises are required for a year's work in General Science, and the student's note book should show his work on each of the exercises.
6. Prices for individual items are not given, as they will probably vary considerably before this bulletin is revised.

EQUIPMENT LISTS

The lists below are arranged in three parts—A, B, and C. A minimum for a Group III high school consists of one set of each (A, B, and C). A minimum for Group II consists of one set of B and C, and as many sets of A as there are groups of four students in the class. Group I schools will be expected to provide sufficient equipment so that students may do at least 35 experiments. Tables should be provided accordingly.

LIST A—Individual Apparatus.

2 Beakers, Pyrex, 250cc.
1 Battery Jar, clear white glass 100x125 mm.
1 Meter Stick.
1 Ringstand, 2 rings.
1 Glass Plate, 4x4 in.
1 Flask, Pyrex, 200cc.
1 Rubber Stopper, 2-hole, No. 3.
1 Bar Magnet, 1x1x15 cm.
1 Compass, Magnetic, 10mm. diam.
1 Test Tube Holder.
1 Mirror, Plane, 4x15 cm.
1 Thistle Tube.
2 Bottles, wide mouth, 8 oz.
1 Alcohol Lamp, 4 oz.
Note—If gas is available and order: omit the last item above
1 Bunsen Burner.
3 ft. Rubber Tubing, ¼ in. (Sold only in multiples of of three feet.)

LIST B—General Stock
For a Class of 10 to 20 Students.

12 ft. Rubber Tubing, 3-16 in. (Sold only in multiples of three feet.)
2 lbs. Glass Tubing, 5 to 7 mm. assorted.
1 lb. Iron Filings.
1 Vial Litmus Poper, Blue.
1 Vial Litmus Paper, Red.
1 box Christmas Candles (24).
1 lb. Copper Wire, insulated, annunciator.
48 Test Tubes, 5x5-8.
12 Bottles, wide mouth, 8 oz.
12 Corks, No. 18
12 Test Tubes, 8x1.
5 Rubber Stoppers, 2-hole, No. 4
2 Flasks, Pyrex, 500 cc.
2 Rubber Stoppers, 2-hole, No. 6.
1 lb. Acid Hydrochloric.
1 lb. Acid Nitric.
1 lb. Acid Sulphuric.
4 oz. Acid Oxalic, Cryst.
1 lb. Copper Sulphate
4 oz. Fehling's Solution "A"
4 oz. Fehling's Solution "B"
1 lb. Manganese Dioxide.
1 lb. Marble Chips.
1 lb. Potassium Chlorate, Cryst.
1 lb. Sulphur, flowers.
1 lb. Zinc, mossy.

LIST C—Class or Teacher's Demonstration Apparatus.
One set for the whole class.

1 Triple Scale, steel bearings.
1 Set Weights, iron, slotted, on holder, 10 to 500 grams.
1 Burette Clamp.
1 Condenser, Liebig, 15 in.
1 Condenser Clamp.
1 Air Pump, vacuum and pressure.
1 Air Pump Plate, with stopcock.
6 Feet Rubber Tubing, ¼ in.
1 Bell Jar, glass stoppered.
1 Barometer Tube, pipette and mercury well.
1 Magnetic Compass, 50 mm.
1 Electric Bell, 2½-inch gong.
2 Push Buttons, pressed steel.
1 Clamp Holder.
1 Graduate, Cylindrical, 100 cc.
1 Calorimeter, brass, nickeled, 75x125 mm.
1 Lift Pump, glass model.
1 Force Pump, glass model.
2 Pulleys, single.
2 Pulleys, triple.
1 Osmose Apparatus.
1 Washington School Collection Rocks and Minerals, 20 each, in tray, labeled.
1 Electroylsis Apparatus.
2 Dry Cells.
1 lb. Mercury.

Total cost, Lists A, B, and C, should not exceed $85.00.

ADDITIONAL APPARATUS RECOMMENDED

1. Microscope, 65D (or equivalent), 2 eyepieces, 2 objectives, double nosepiece, in case. $58.
   (NOTE—One of these microscopes should be in every school.)

72 Slides, blank, 25x75 mm. $1.50.
½ oz. Cover Glasses, No. 2, round, 18 mm.
1. Section Razor, $2.75.
1. Barometer, Aneroid. $15.
1. Rain Gauge, Weather Bureau Type. $4.50.
1. Telegraph Set, Key, and Sounder. $4.20.
2. Pkgs. Co-ordinate Paper (80 sheets). 50 cts.

An "Erector" or a Meccano" set; a "Chemcraft" set; and a working steam engine can be bought in any good toy or hardware shop, and are especially good for science clubs, automobile clubs, etc.

Practice Work in Training for Chemical Engineering[1]

R. T. HASLAM

The urgent need of men trained in both chemistry and engineering is great but until recently the preparation of these men has been too academic, there being little opportunity to get practical experience until the graduate was "on the job."

To overcome these difficulties, Dr. A. D. Little proposed a cooperative course in Chemical Engineering in which the Massachusetts Institute of Technology would unite with progressive chemical industries in the training of student engineers. The cooperating companies permitted the use of their plants as a laboratory, and the faculty of the Department of Chemical Engineering at the Institute supplied the instructional staff. This plan, incorporated in the School of Chemical Engineering Practice, was first tried out under the direction of Dr. William H. Walker in 1917, and although in successful operation when the war broke out, it was discontinued, since practically the entire staff and student body followed Col. Walker's lead in entering war activities. In 1920 the work was re-started and the following is a brief outline of the plan, methods, and lessons learned to date.

STRUCTURE OF THE SCHOOL

The School of Chemical Engineering Practice is composed of three field stations, each established in an industrial center, and each having access to the plants of two or three chemical industries. Each of these three stations is in charge of a member of the Institute Faculty, with suitable instructional assistance, and

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1 Abstract from Jo. Ind. & Eng. Chem. May 1921.

the entire time of these men is devoted to the educational work of the stations. The students, entering this school after graduation from the university or technical school, are divided into three groups for assignment to the three stations. After spending eight weeks at the assigned station, each group proceeds to the next station, and by this division and rotation the work of the entire school is covered and completed in twenty-four weeks. The three stations are located at Bangor, Maine, Boston, Massachusetts, and Buffalo, New York. The companies cooperating in the establishment of these stations are: Bangor Station—The Eastern Manufacturing Company and The Penobscot Chemical Fibre Company; Boston Station—The Merrimac Chemical Co., The Revere Sugar Refinery and The Boston Rubber Shoe Company; Buffalo Station—The Lackawanna Steel Company and the Larkin Company. These industries include the manufacture of sulfite and soda pulp, writing paper, electrolytic caustic soda and chlorine, the production of heavy acids and chemicals, the refining of sugar, the manufacture of rubber products, the manufacture of iron and steel, gas and coke (including by-product recovery), and soap and glycerol. After the completion of work at the practice stations, the student returns to the Institute for two terms of work which is wholly elective, and this enables him to specialize in that branch of chemistry and engineering in which he is most interested.

There are three points of diversion between the School of Chemical Engineering Practice and other cooperative courses of instruction:

1—The men in the school devote their time wholly to intensive educational work and therefore they receive no pay from the industries, since they do no direct productive work.

2—Owing to the methods used and the type of instruction, it is first ncessary that the students receive their fundamental theoretical training before going into the Practice School, and to insure such a thorough foundation only the best graduates of the Institute of Technology or other university of recognized standing are admitted.

3—In order that the instruction may be truly intensive and individual only ten or twelve students are taken into a single group, and this group is always under the direct and immediate supervision of an assistant professor with an instructor as an assistant.

We believe these points to be vital in the development of high-grade graduate engineers.

DIVISION OF THE FIELD OF CHEMICAL ENGINEERING

It is impractical to study chemical engineering in such widely different plants in a haphazard manner. The work must be well organized and the time at each factory spent most advantageously on those phases of chemical engineering which are best adapted for study at that particular plant. To facilitate this the field of chemical engineering has been subdivided into "unit studies."

We believe, moreover, that the principles underlying each unit operation may be made clear to the student by a searching study of the operation under one or two sets of conditions. After careful consideration, the field of Chemical Engineering has been divided into "unit studies," of which the following are most important:

UNIT STUDIES IN CHEMICAL ENGINEERING

I—Transfer of Energy
II—Transfer of Materials
III—Preliminary Treatment of Substances
IV—Separation
V—Reaction Processes and Methods
VI—Plant Design and Construction

Owing to lack of time and facilities all of the above operations are not emphasized. However, as the chemical engineer controls chemical forces largely by controlling the flow of energy (heat) and the flow of material into or away from the reacting zone, these operations and their basic effect on the others are examined in detail. In addition, important operations, such as combustion, evaporation, distillation, drying, filtration, plant layout, etc., are studied in a most through manner.

METHOD OF TEACHING

The method of teaching the principles back of the unit operations has been given much attention. Allowing men to operate machines gives them only a rough qualitative idea of the process, and we have not found work on "labor shifts" to have much technical educational value. The method which gave the best results and which we found to be the most advantageous is the use of quantitative tests on the operation by the students themselves. The students are usually asked a question as to the quantitative effect of some change in operation, and they there-

upon design a test, carry it out, and work up the results on the operation in question. This work of designing the test is done by the student, and he plans and carries out the work in its entirety. He decides as to the data needed, how they should be obtained, the methods used in calculating his results, and what results are needed to form a sound engineering judgment on which a recommendation may be made that will improve the method of operation. Thus the most difficult part of plant testing is done by the student, properly guided by men of experience.

Furthermore, throughout the entire plant work the student is obliged to apply the knowledge obtained in his undergraduate work to the practical problems about him. Three of the most important uses of theory in practical work are: To enable one to obtain the data required with the minimum trouble and expense, to get the maximum of information from the data obtained, and from the present performance to predict the results of possible modifications of industrial conditions. It is obvious that tests of the sort outlined above afford unrivaled opportunities for such training in the correlation of theory to practice.

CONCLUSION

In conclusion, we believe the work of the School of Chemical Engineering Practice may be summed up by stating that seven industrial concerns permit the use, under suitable regulations, of their plants as laboratories of chemical engineering, and that instruction in these laboratories is given to small selected groups of trained men, by resident faculty members of the Department of Chemical Engineering of the Massachusetts Institute of Technology. We believe it to be a great tribute to the broadmindedness of American industries, and to these seven concerns in particular, that they are willing to cooperate in such a wholehearted manner in the training of the young engineers of tomorrow.

Some New Lecture Table Experiments in Chemistry[1]

HERBERT F. DAVISON, Brown University

GAS DIFFUSION APPARATUS. To demonstrate the rapid diffusion of light gases and to illustrate the principle on which mine gas detectors are based we show at Brown the apparatus illustrated by Fig. 1.

1 These were demonstrated at a meeting of the General Science Club, May 1921.

The porous cup is from a Fuller cell. The stopper is paraffined by soaking it in hot paraffine. The glass device for the contact maker is one piece with sealed glass joints. It however can be made with rubber joints if this is more convenient The carbon rod may well be the "lead" from a pencil. It should fit loosely in its tube. The platinum wire should be fairly heavy to stand some handling without breaking off. To obviate general breakage of the whole apparatus, it should be mounted on a single standard. The current is from the ordinary lighting circuit. The liquid in the bulb is 10% sulphuric acid.

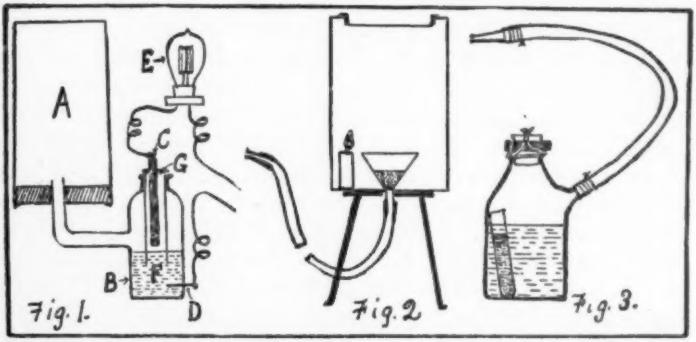


FIG. 1. GAS DIFUSSION APPARATUS. A. Porous cup 25 cm. long with paraffined stopper. B. All glass sealed joints about 4 cm. long and 2 cm. in diameter. C. Carbon pencil. D. Platinum wire sealed in. E. Electric light for city circuit. F. Ten percent sulphuric acid. G. Small rubber ring to hold pencil, but not making a tight joint.
FIG. 2. DUST EXPLOSION APP. FIG. 3. FIRE EXTINGUISHER.

The operation of this device is so delicate that if a stream of illuminating gas is directed toward it from a distance of, say, two feet, the liquid in the bulb will rise into the inner tube and complete the circuit through the lamp. A few trials will give the correct adjustment. The removal of the gas stream causes the reversal of the action and the light goes out.

A DUST EXPLOSION. A dust explosion may be easily shown with the apparatus shown in Fig. 2.
The can is one in which salted peanuts are sold and has a "friction top." A hole is made in the bottom and a glass funnel inserted. A rubber tube about a meter long is attached to the funnel and has a fire polished mouthpiece over the other end. The device is mounted on a tripod.

To operate, pour into the funnel about 25 cc. in bulk of lycopodium powder. Next place a lighted candle on the bottom

near the side. Put the cover on securely and blow hard through the rubber tube.

It is best to put the candle in *after* putting in the lycopodium powder, because otherwise the dust produced in pouring might become ignited and flash into the operator's face.

A SIMPLE FIRE EXTINGUISHER...A very simple and sure fire extinguisher can be made as shown in Fig. 3. A side neck, thick wall, suction flask has a length of rubber tubing fastened securely to the side neck. This is best done by filing or grinding notches into the glass and then binding the tubing on with brass or copper wire. A nozzle is slightly flanged so that it can be securely wired into the other end of the tubing. A wire clamp such as comes on a soda bottle (for sale at 5 and 10c stores) is used to hold the stopper which is rubber.

A saturated solution of bicarbonate of soda is put in the flask to a depth of about eight centimeters. A ten centimeter long test tube is filled with concentrated sulphuric acid, and placed gently upright in the bicarbonate solution. The stopper is clamped and it is then ready to operate by inverting.

IGNITION POINT OF CARBON BISULPHIDE. Place not over 5 cc. of carbon bisulphide in a shallow dish. At a distance, gradually warm a chemical thermometer in a gas flame until it is registering about 160°. Quickly carry it to the dish of carbon bisulphide and hold it near the surface of the liquid, which will then take fire. As samples of the carbon bisulphide vary, some some other temperature than 160° may be required.

ACTION OF ALUMINUM AND IODINE. A beautiful experiment to show the vigorous action when these two elements are brought together moist can be shown by taking equal measures of dry powdered iodine and powdered aluminium, mixing them thoroughly and pouring the mixture out into a conical pile on a piece of asbestos. A ten centimeter test tube is a convenient measure. The pile is best put into the hood, as dense fumes are evolved in the experiment. When all is ready drop about 3 drops of water on the top of the pile. In a moment the whole mass will be ablaze.

FREEZING WITH AMMONIUM NITRATE. A box about 18 inches in length is placed bottom up on the lecture table. Two or three cubic centimeters of water are poured out on the middle of the bottom. On this little pool of water a 300 cc. beaker is placed. The beaker is filled one-third with granular am-

monium nitrate. An equal bulk of water is poured in and the mixture stirred with a wooden stirrer. In a moment the beaker will be frozen to the box, and the latter may be picked up from the table using the beaker as the handle.

Interviewing an Elephant

B. CLIFFORD HENDRICKS, University of Nebraska.

Have you heard the story of the four blind Hindus and the elephant? They went to "see" the elephant. One approached the giant beast from the rear and touching the tail remarked, "I perceive that the elephant is very much like a rope." Another met one of the animal's legs as he groped forward and said, "Nay, but he is more like a tree trunk." The third observer came first to the elephant's ear. He said; "I agree not with either of you for I find the elephant like a huge leaf." "The fourth and last of the visitors happened to come to an ivory tusk as he advanced. He agreed with none of his three colleagues. "You are all in error," said he, "this elephant, I find, is hard and smooth like a pebble stone." As I remember the story, so animated became the argument over the qualities of the elephant, the four observers retired to a distance from the animal to "argue it out."

The writer has found this story very fruitful as an illustration of some things we should bear in mind as we teach science.

In the first place, it aptly shows that a complete concept does not come with the first presentation of the new material. A concept does come, such as it is, with this first observation but we as teachers must recognize its limitations and plan to give it more and more content as the work progresses. The old adage, "One swallow does not make a summer" is another way of saying the same thing.

In the second place, even if these four Hindus had accepted each others observations at par, their notion of the elephant would still have been incomplete. Should they be allowed to go their way with only this half truth? Shall a teacher insist that each pupil "know it all" before he is allowed to advance to a new field of endeavor? Is it permissible to accept definitions, for example, that express the child's conception of that which is defined, incomplete as they are, or shall the teacher impose a "made to order" definition upon him?

Third, the Hindus, as they *studied* the elephant, related the

qualities of the elephant, as they discovered them, to the same qualities of objects within their experiences. Perhaps this definition of *study* would not meet the approval of a psychologist. However, it has been found helpful and useable by the writer in his method courses. What kind of experiments shall be given to the general class? Those which help the student to *relate* the thing taught to the pupil's experience. What sort of questions or exercises shall the teacher ask or assign? Those that *relate* the term or principle to the student's experience. What do we mean by applying the principles, say of chemistry? First, it is *relating* that principle to the experience of the individual, second it is *relating* that principle to the experience of the race. A pupil says, "I don't understand." What does he mean? He has not *related* the non-understood thing with enough of his experiences. What did the elephant mean to the Hindus? It meant; rope to one; trees to another; leaves to the third and smooth hard pebbles to the last. Had each of the four Hindus secured more first hand information before stopping to quibble with his friends his understanding of the animal would have been more complete. Instead of *relating* it to one experience he would have *related* it to four or more; it would have had more meaning for him.

Again, the story suggests the spirit that should characterize our teaching. We condemn the Hindus not for their partial knowledge but for their "know-it-all" spirit. Isn't gossip, mischievous gossip, nothing more than partial truth proclaimed as the whole? Doesn't the fault lie with the gossip's early training? Is it not that she was not made to realize that fulness of knowledge comes only from many and diverse observations and not from just one whispered suggestion over the back yard fence? We'd as well admit it. All knowledge is partial. Let's stress this with our pupils. We know so much today but tomorrow we shall know more. Let's keep "open house" for the new when it comes.

Bacteria and the Telephone

Early in the history of modern bacteriology, when the ubiquity of bacteria and the harm which certain micro-organisms can do was beginning to be demonstrated, the widespread search for these microscopic enemies became a popular exercise among trained observers. Everywhere about us the newly

exploited hidden dangers loomed up; in food and drink, in our clothing and shelter, on the earth and in the air bacteria continued to be discovered. For a time it seemed as though few places were healthful habitations, few environments fit to be called sanitary. Gradually, however, it began to be realized that not all bacteria are baneful. Not a few are veritably beneficent. Furthermore, man is well equipped with a variety of remarkable protective devices to withstand invasion. Natural immunity is something which rarely forsakes us; for in the midst of innumerable unseen foes man usually survives.

Despite the sense of security which has gradually developed among persons living in a bacteria-ridden world, preventive medicine has not allowed mankind to become entirely indifferent toward germs. Sterilization and disinfection brought about by cleanliness and by chemical and mechanical agencies have been introduced into many aspects of everyday life. The public drinking cup has given way to drinking fountains and the individual sanitary cup. The common towel is a rarity in public places. The sealed package has replaced the exposed assortment of food products. Dirty money has been demonstrated to be unsightly rather than infectionus. The sputum box has replaced the cuspidor. Air and sunlight are being given a chance to do good.

The human carrier represents a new sort of menace in the struggle against disease. So long as we have reason to fear him, the sources of direct or indirect contact with him must be kept under scrutiny. With this thought in mind we refer to a recent investigation by Saelhof in Chicago on the bacterial content of telephones. It has been frequently asked whether or not they can transmit disease. The late epidemics of respiratory diseases have made the inquiry more pertinent in the case of instruments used daily by thousands of persons in public places. Cultures prepared from the receivers and transmitters of ninety-four representative telephones located in public booths enabled Saelhof to isolate various pathogenic bacteria. One sixth of the instruments harbored hemolytic streptococci; diphtheria bacilli were present in 2 per cent. Nearly all of the former were viable. In comparison with the transmitters, the receivers showed very few pathogenic microorganisms.

This discovery does not represent a serious situation, and one

can scarcely believe that the telephone plays an important part in the transmission of disease, as it does of human words. Saelhof conservatively concludes that however slight the danger, the point is worthy of recognition that the telephone is an instrument on which dangerous bacteria are commonly deposited and there continue to live for some time. The source of infected material should be known, and as a possible danger under certain conditions should be given proper consideration. Whether sterilization of the instruments should be practiced to prevent the spread of virulent organisms may be debatable; but the question cannot be overlooked.

Jo. of Am. Med. Assn. June 18, 1921.

Renting vs. Owning A House

RESOLVED: THAT IT IS BETTER FOR ONE TO RENT THAN TO OWN THE HOUSE HE LIVES IN.

AFFIRMATIVE: MOLLY R. DOE, Marblehead Mass.
NEGATIVE: AGNES E. HART, Beverly, Mass.

THE ADVANTAGES OF RENTING A HOUSE

At the present time when prices are so high a question much discussed is, "Is it more profitable to buy or to rent a home?" Arguments are advanced on both sides of the question according to one's experience in the matter. It seems however that for the average wage earner to rent a house is much more feasible. Some of the arguments which point out this fact are as follows:

The renter has no taxes to pay. He pays his rent by the month, settles his household expenses by the week and balances his account. He is not troubled with planning to meet an income tax, water rate, property tax and the like. All of these fall to the lot of the landlord.

The renter may change his place of residence in a short time if necessary. Perhaps the renter is obliged to move because his work calls him to another locality. He merely has to find a home to rent and to pay the moving expenses. The owner of a home would perhaps lose valuable time by waiting to dispose of his house. If the renter is obliged to move to a different climate because of ill health every minute of time wasted in making the change means a slimmer chance of recovery. He has the advantage here also over the owner who is hindered in the disposal of his property.

The renter has the right to demand that the house be in a

certain state of repair. It is of course the landlord's business to make the necessary repairs, the tenant's to keep the house as well as he can.

A once desirable locality may change because of the introduction of a new industry, a factory or an undesirable human element. The renter has no ties which bind him to this place, he is free to go out any time. The house owner besides being held by his property may also find that same property greatly reduced in value.

The high cost of building materials, labor and property do not visibly affect the renter. He meets the usual expenses every month and then begins to save for the next.

It may be especially advantageous to a business man to rent his home. He can use the money his house would cost in his business and in this way improve his business. Since he spends the greater part of his time in his office and in commuting he has little time to care for property as would be required of a home owner. It is more profitable in that respect for him to rent his house. Again the business man may make more use of his leisure time than the owner. He may use it to benefit and advance the whole community. He has time to discuss national questions with his neighbors or decide how to vote. He may attend lectures or even give talks himself on various topics of interest. He may read widely, at any rate he may make himself a better citizen by judicious use of his leisure hours.

In case of fire or any other destroying element the renter loses only his furniture. It is the landlord who stands the brunt of the loss since his property is destroyed.

Finally, it is almost imposible at present for the average wage earner and supporter of a family to save enough money to invest in a home. To such people who are unable to pay the high rate of interest the privilege of renting a home is a blessing indeed.

To sum up, it is better to rent a house for these reasons:

1. The renter of a house has no taxes, insurance on the house, interest on mortgage or water rates to pay.
2. He has a right to demand certain repairs and does not have to pay for them.
3. He is able to change his place of residence at any time if his work or health demands it.

4. If the locality depreciates he can move to a more desirable place.
5. The renter makes better use of spare time. Instead of caring for property he may prepare for a better citizenship.
6. Cost of building and expense of keeping in repair make the owning of a house too expensive for the average man.
7. It is better for a business man to use his money in business than in a home.

The advantages of owning a house

In this question of owning or renting a home there are points to be considered for both sides, but I believe you will agree with me that it would be better for every family to live in their own home.

The home owner is a better citizen than the renter "the stability of the government depends on wide ownership." Through ownership discontent and disorder are prevented. Abraham Lincoln said, "Let him not who is homeless pull down the house of another but let him work diligently and build one for himself, thus by example assuring his own shall be safe from violence when built." The home owner favors good government, better schools and improvements of all sorts. He is interested in his community and his influence is greater than that of the renter.

Again what better investment is there than in owning a home. How much better it is than stocks and bonds for you have personal advantages. One can keep the home and increase its value by improvements. But when one buys stocks he can never be sure that they will not decrease greatly in value.

Does not the home owner feel more independent than the renter? He has self-esteem and personal pride. Franklin said "Now that I own a pig and a cow everyone bids me good morning." One may say that the renter is more independent for he can move anytime and change his locality. That is true so far but if he wants to move has he a place where he can go? Do you stop to consider that every time one moves there is much expense incurred? Who is more independent the man who owns his house or the one governed by the whims and wishes of a landlord? Repairs, new wall paper etc., can be had at any time by the owner, but the renter may have to wait years for them.

Is not the owner farther ahead in the end by owning his

home? Think of the money the renter pays year in and year out for rent and he has nothing to show for it. The owner moreover can rent part of his house to these very renters I have been speaking about thereby defraying some of his expenses.

An owner has influence in his community so that undesirable neighbors or industries can be ejected and even prevented from entering his community. If for any reason such as illness a house owner is compeled to move he can sell his home for ready money. Can the renter do this? This ready money will be a goodly sum for the improvements which any owner makes in his house will increase the value.

What will the renter do in his old age? The owner will have a place to lay his head. No matter what happens, he has a place to go and above all he owns that place.

In conclusion let me repeat the reasons why it is to one's advantage to own his home.

1. The home owner is a better citizen.
2. A home is a better investment than stocks or bonds.
3. The home owner can improve his home and increase its value.
4. If a man builds his house he can have any type and choose his own locality. He also feels more independent because he is not under a landlord.
5. He may rent a part of his house and so make it a source of income.
6. He may use his influence to control the neighborhood and thus prevent unwelcome factories or unsuited classes of people from moving there.
7. His home provides for his old age.

Beginnings of the Art of Dyeing[1]

EMILE CAGLIOSTRO

Dyeing is as old as the textile industry itself, and this antedates the written documents of human history. Closely connected with the utilitarian desire of human beings to protect themselves from the inclemencies of the weather is the desire for artistic effects to be obtained in coloring the materials of which these protective coverings were made. From the Greek

1Extract from the very interesting and complete article entitled, "History of Dyeing," by Emile Cagliostro in the COLOR TRADE JOURNAL, Oct., Nov., Dec., 1919. Reprinted by courtesy of DYESTUFFS. Where the extract appeared in the Sept. 1921. number.

mythology we learn that Ariadne, the goddess of spinning and weaving, was the daughter of Idon, the dyer of wool a truly interesting chronological comparison, and one showing how intimately the art of dyeing was connected with its sister arts.

In ancient times dyed fabrics were only enjoyed by the wealthy, as they were too expensive to be used by the great mass of people. Certain colors were so costly, in fact, that their use was restricted to royalty or to the service of religion. (See Exodus, chapters 26, 28, 38, 39.) Plutarch, in "Iside and Osiride," chapter 78, tells us that the robes or sacred vestments of Isis were of various colors; but those of Osiris were of one bright color. Juno, Venus, and Proserpine were usually represented by the ancient poets as being robed in purple.

Perhaps the earliest authentic records we have concerning the industrial life of the ancient nations are those contained in the historical classics of the Chinese; in these we find mention of the dyeing of silk in various colors as far back as 2600 B. C. The dyestuffs employed were those obtained from various plants.

It appears that wool was never worn in China except as a substitute for fur, and that cotton and silk, being the only substances ever dyed, received their colors from vegetable coloring matters; these colors were principally red, blue, violet and what is called a woad (wood?) color.

Dyeing, together with its related industry, printing, appears to have been practised at very early times by the various East Indian nations, long before their migrations led to the settlement of Asia Minor and Europe.

......Remnants of dyed fabrics of great antiquity have.... been recovered from Egyptian tombs. A garment dyed with indigo has been found in Thebes, dating from 3500 B. C., and archaeological researches have shown that the Egyptians dyed iron buff and used the yellow coloring matter of the safflower in dyeing as early as 2500 B. C.

Indigo as a dyestuff was known in very early times and was extensively employed, especially in Asiatic countries, for the production of blue colors. While the inhabitants of India appear to have used indigo as a dyestuff (by reduction in a vat), from time immemorial, the Greeks and Romans seem never to have learned its use in this connection, but only applied it in the powdered form as a pigment or paint.

Pliny, in a chapter relating to "The Colors of Cloth Resembling Those of Flowers," laments the introduction of new bright shades as subversive of good taste. He also rails against the new dyes and methods of dyeing invented by the outlying provinces, the French.

At the opening of European history the Phoenicians appear to have been renowned for their skill in dyeing, and their beautifully colored fabrics became articles of extensive trade with other nations. The celebrated "Tyrian Purple" appears to have had its origin among the Phoenicians, and its beauty and high price made it a badge of royalty. The dyestuff was ob-

tained directly from shell-fish, collected along the coast, 12,000 being used .... with a yield of 1.4 grams of pure color.

Pliny describes the Egyptians as practicing a species of topical dyeing, or calico printing, which .... appears to have been similar to that which, many ages after, was found to exist in Hindustan, and was later introduced into Europe.

A dyeing establishment in 1568. The color was applied by running the fabric through the dye liquor in a large vat, after which the cloth was dried in the open air.

Plutarch tells us that in Rome dyeing was carried on as a handicraft, which Numa Pompilius endeavored to encourage and foster by establishing a college in the interest of this art. This "collegium tinctorium" is interesting to us as being probably the first school of dyeing ever established.

The Romans were acquainted with a number of different coloring matters, and divided them into major dyes and minor dyes; the first were used for dyeing garments for both sexes,

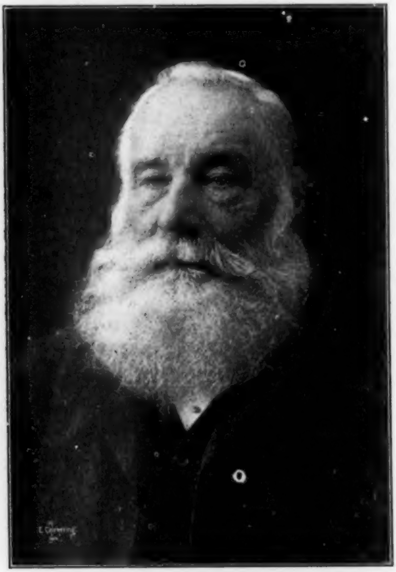
whereas the second were employed solely for either men or women, as the case might be. Yellow, for instance, was only used for dyeing bridal garments. This was truly a remarkable sociological classification of dyestuffs.

The Venetians appear to have been the first of the modern European nations to acquire any skill in the art of dyeing. We find a reference in the historical records of Venice in 1194 concerning the importation of Indigo and Brazilwood from India. ....Although Indigo was employed in India at this time it does not seem to have extended over the rest of Europe when the subsequent decadence of Venice and its industries led to the widespread dissemination of the art of dyeing over entire Europe.

A quaint old Persian tradition states that Christ was a dyer, that He was appreciated to a dyer who instructed Him to dye fabrics of different colors; Christ placed all the materials into one vat, and the dyer when he took them out found to his great astonishment that they were each dyed the shade required.... ......In Persia a dyehouse is called "Christ's Workshop."

Up to the middle of the last century, dyeing had a rather gradual and even development, though but little attempt was made towards a scientific study of the subject; but the year 1856 brings us to a period of revolutionary development. It was in this year that Perkin, an English student working in the Royal College of Chemistry in London, discovered (during a search which had for its object the synthesis of quinine), that the oxidation of aniline yielded a beautiful violet coloring matter of great tinctorial power. He perfected this discovery in his own rough laboratory at his house. This was the beginning of the era of artificial dyestuffs prepared from the various products of coal tar, and proved to be an important landmark in the industrial development of chemistry. Not only did this discovery bring about a complete revolution in the methods of dyeing through the preparation of numerous artificial dyestuffs, but it also brought the art of dyeing into a more intimate and direct connection with the science of chemistry, which was then growing with great rapidity.......... The discovery of the coal-tar colors opened up a wide and most lucrative field for chemical research, and this soon led to a close association of dyeing and chemistry..........From the dyestuffs themselves, the chemist was led to an investigation

of the processes and methods of dyeing, and a chemical study of the fibres, and mordants, and the action of the various drugs employed. The result was that order and system, and knowledge of underlying principles in dyeing were soon introduced, where before everything had been more or less obscure and chaotic and dependent upon rule of thumb methods......



Sir William Henry Perkin, the great English chemist who in 1856, first produced a dye from coal-tar distillates. It was a beautiful violet, known for years as "Perkin's Mauve." Sir William lived to see the wonderful development of a new industry—the coal tar dye industry—as a result of his discovery.

......The introduction of the coal-tar dyes made it possible to obtain colors which had hitherto been the despair of the dyer; and the latter has now at his command the most varied shades, and the most delicate and brilliant hues.

.... * * * * * Much is said .... of a derogatory nature concerning the modern colors, while the fastness of the old dyes is highly extolled. If we examine .... the former vegetable dyes we will find that perhaps the fastest one of all is indigo; .... as this identical dyestuff is now

prepared from coal tar, we need not proceed any further with the comparison in regard to it. ....Red was formerly dyed almost exclusively .... with madder on previously mordanted wool; as the coloring principle of madder is made at the present time from a derivative of coal tar, and is identical in every respect with that occurring naturally in the vegetable dyestuff, we have at our command the same conditions of fastness as the people of antiquity; we have also far extended our range of fast colors in this respect by the preparation of blue, yellow, brown, green, and black dyestuff belonging to the same class as alizarine red (madder) and possessing similar dyeing qualities. Weld and Persian berries appear to have been the fastest yellow dyes possessed by the ancient dyers and these do not compare to our alizarine yellow (and some other coal-tar yellows) in respect to fastness and clearness of shade.

So complete and radical has been the transformation of the tinctorial art of the world, since the introduction of coal-tar dyes, and the change of dyeing processes has been so rapid, that the older methods of producing various colors bid fair to be lost to the memory and to the authentic records of scientific and technical literature. .... The subject, however, is well worthy of extensive antiquarian research, and would no doubt prove a field of very fruitful labor.

Saving The Eyesight

Inefficiency Due Largely to Imperfect Sight

In a careful examination of ten thousand industrial and commercial workers, active in their work and supposedly in good condition, fifty-three percent showed defective vision uncorrected. It is an absolute fact that many employees are accused of inefficiency and carelessness when it is entirely a matter of imperfect vision.

The motion picture camera is made in imitation of the eye. The better the condition of the lens and the better the illumiation of the object the better the result of the photographers' effort. Just so with the more perfect instrument, the eye. It behooves every one to see that his eyes are kept in good condition and free from eye-strain coming from defects which may be corrected by glasses, or the strain due to improper lighting.

SAVE AND PROLONG THE USEFULNESS OF THE EYES

A well-known specialist addressing a national conference stated: "for every blind person we generally can count from one to three who are what is termed near-blind, and a still greater number with markedly deficient vision. So we may continue to estimate until we come to what seems an almost universal lack of eye perfection.

"We shall better understand by the number of young men between the ages of twenty-one and thirty-one years who were refused entrance to the army because of deficient vision; so deficient that the glasses failed to bring it up even sufficiently for one draftee to be acceptable for limited service.

"Just as it is necessary for school children to be examined so every individual between the ages of twenty-one and thirty-nine years should have the ocular state ascertained, as was done in the case of the army draftees.

"Early tendency toward the development of cataract may also occur during this period. Refractive errors (defective vision) when corrected lessen this tendency. Correction of defective eyesight, therefore, is a stitch in time, for it will save and prolong the usefulness of the eye."

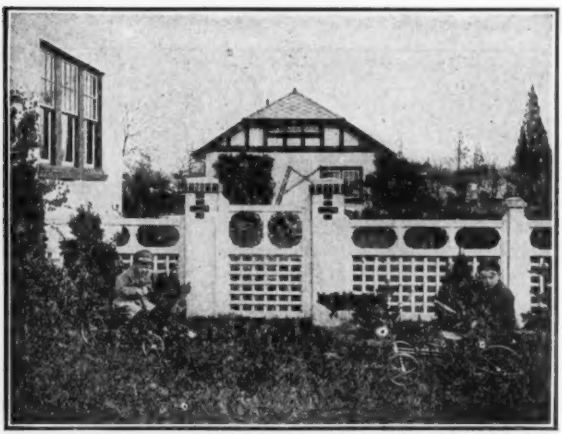
CONSERVATION OF SIGHT

Two types of patients consult specialists about their eyes—those having difficulty in seeing and those suffering from headache, eye-ache, and various nervous disturbances.

Imperfect vision is not always apparent to persons so handicapped for they, having always seen objects blurred or distorted, believe they see as others do. It is by comparison only that we can tell whether or not our sight is up to the established standards.

Compare the illustration marked normal vision, (see page 315) with the others, which are reproductions of the visual pictures as seen by defective eyes.

People who have but slight defects are the ones who invariably suffer from headaches and the various nervous disturbances caused by eye-strain, because the eye muscles can exert enough effort to overcome the small errors, but this continued strain is bound to produce some eye-strain symptoms. Therefore, it is advisable for all who have these symptoms to consult an experienced examiner, even though their sight appears to be normal on the vision charts.

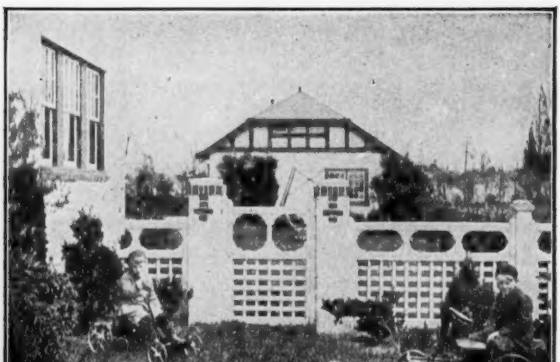


NORMAL VISION

With normal sight every line and all portions of an object are correctly pictured in the eye, without strain.

Compare illustrations in the following order:

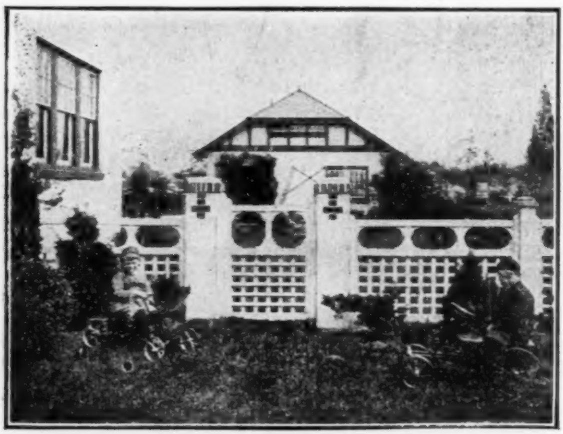
Page 315 with 316 and 317.
Page 315 with 318 and 319.
Page 315 with 320 and 321.



SLIGHT ASTIGMIA

VERTICAL LINES BLACKEST

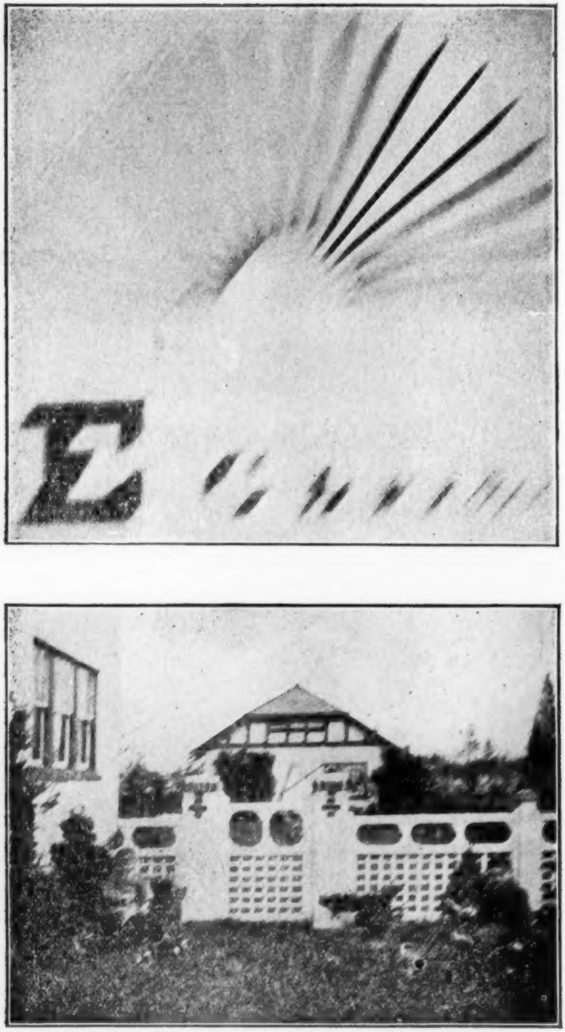
Note that the small letters are blurred and distorted, also that the lines nearest vertical are the clearest in both illustrations. By muscular effort this slight defect can be overcome, but one is liable to suffer from headache and eye-strain in consequence.



SLIGHT ASTIGMIA

HORIZONTAL LINES BLACKEST

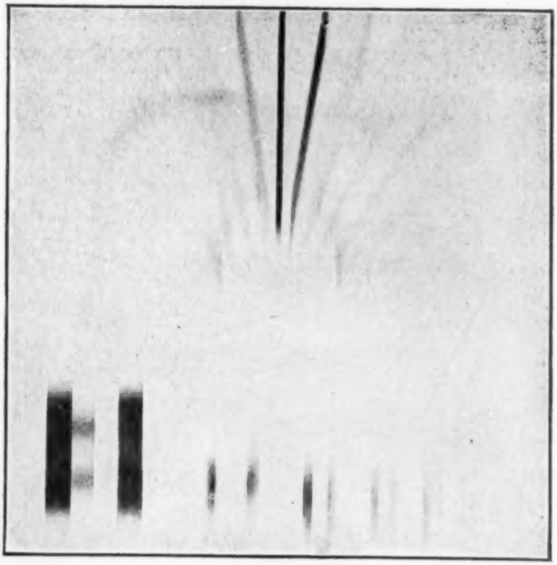
This is slightly more defective. The letters are more blurred and distorted, and the lines nearest horizontal are the clearest. This illustrates why some people, especially children, miscall letters when reading. (See preceding pages, 315 and 316.)

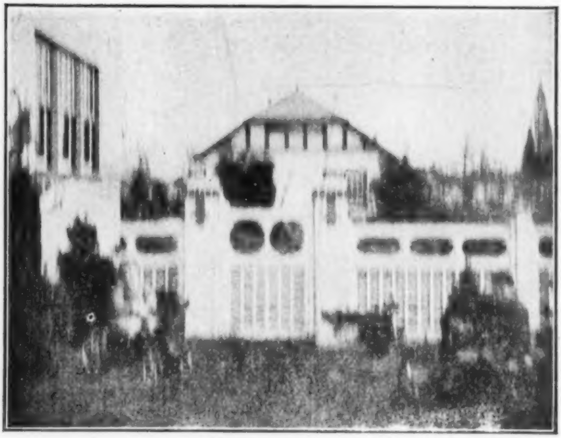


MEDIUM ASTIGMIA

OBLIQUE LINES BLACKEST

Another form of astigmia, showing the oblique lines clear, and picturing further distortion, in fact, a distortion too great to be overcome by muscular effort. Eyes so affected have greatly reduced vision.



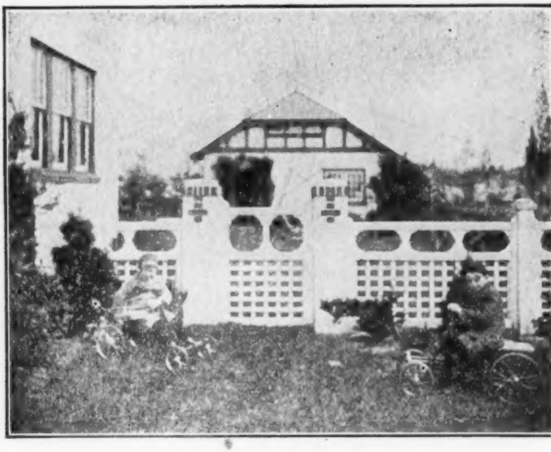


HIGH ASTIGMIA

VERTICAL LINES CLEAR

Here we have an extreme case of astigmia.

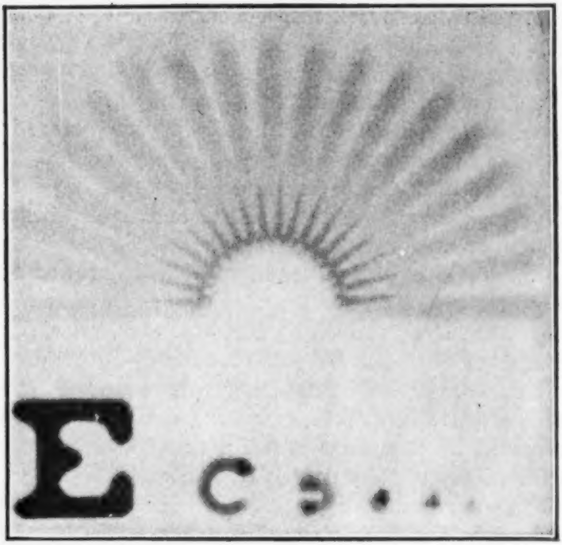
Most of these cases can be corrected and made to see normally with lenses. The comparison between the corrected and uncorrected vision helps us to understand why some people complain of objects looking unnatural when they first put on glasses, also why they misjudge distances until they become accustomed to seeing correctly.

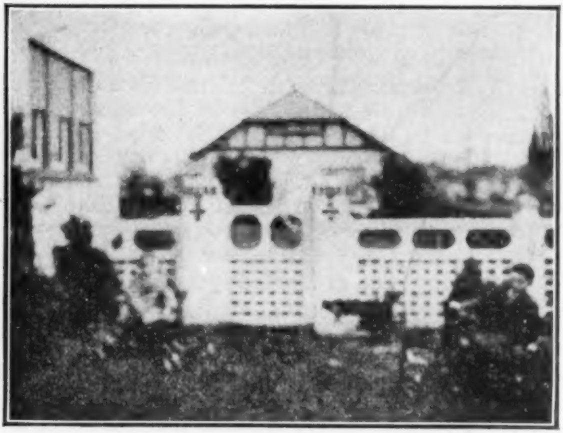


SLIGHT SPHERICAL ERROR

Eyes too short or too long, but otherwise perfect, blur the appearance of objects equally in every direction and in all parts. The above illustrations represent a slight degree of spherical error.

Note that blur is not marked except on small letters, showing why these defects often go unnoticed.





HIGH SPHERICAL ERROR

Here everything is a blur—even the largest letters are but ragged blots; still there are persons whose sight is like this who believe they see as others do.

Defects of vision which can be corrected by glasses are caused by:

1st. The eye-ball being too short—farsight.

2nd. The eye-ball being too long—nearsight.

3rd. The transparent front of the eye covering more in one direction than in another—astigmia.

4th. That natural change in the eyes necessitating for most people the use of glasses for reading and near work after forty years of age.

Since there are several thousand varying degrees of defects that may be corrected, there are also as many different views of the same object when seen by defective eyes. A child with a marked error of vision will see letters and objects distorted and blurred—even his parents' faces will appear distorted.

There is a grave responsibility resting upon those in charge of children to see that their eyes are cared for.

It is the height of folly to neglect one's own sight.

Thorough examination by a competent specialist will permit one to know positively whether or not eyes are free from strain.

The amount of time lost on account of headache and eye-strain, and of material and effort lost from impaired vision is of far greater importance to industry than is generally known.

This loss will be greatly reduced to the benefit of industry and humanity in general when defective vision is corrected.

"Conservation of Sight" in pamphlet form is copyrighted by The Eye Sight Conservation Council of America, Inc., Times Building, New York City. These pamphlets, in packages of ten, will be sent by them to any address upon receipt of 34c. in stamps to cover partial cost and postage.

Caring for the Storage Battery[1]

The storage batteries ordinarily used with gasoline automobiles are simple in construction. No special mechanical skill is needed to keep them in good order, but they do require a certain amount of attention of an elementary kind, and if they do not receive such attention they will probably cause considerable trouble and fail to give satisfactory service. With suitable care and attention batteries sometimes last for three or four years, but many of them become almost worthless at the end of a single season, merely through neglect. Adequate

1 Reprinted from "Travelers Standard" by courtesy of Travelers Insurance Company.

instructions for caring for batteries are furnished by the manufacturers, and service stations are always glad to give expert advice,—usually without charge. Notwithstanding the availability of such information, battery-abuse continues, and therefore it appears to be worth while to issue the present warning, and to describe some of the simple precautions which may be taken, to secure the greatest possible service from a battery. In this connection it may be useful to give a brief general description of the construction of the lead-and-acid battery, which is the type most commonly employed.

CONSTRUCTION OF THE LEAD-AND-ACID BATTERY

The complete battery is made up of several cells,—usually three or more, the number depending upon the electrical voltage desired. Each cell is composed of a number of alternately-arranged positive and negative plates or electrodes, the positive plates in any one cell being all connected together so as to form a single electrical unit, and the negative plates being similarly connected together to form another unit. Each set of plates is carefully insulated from the other set, however, and each set is provided with a suitable terminal for attaching a conducting wire or cable. The plates of each cell are assembled in a jar or container, made of hard rubber or other suitable insulating material. To keep the positive plates in any given cell from touching the negative ones, separators are interposed between them. These are usually made of specially treated wood or of porous hard rubber, and although they prevent the plates from coming in contact with one another, they allow the liquid part of the cell contents to pass freely from one electrode to the next.

The plates themselves are cast from lead, or from an alloy consisting mainly of lead. They are made in the form of grids or grilles and are perforated with numerous small spaces,—which undergo changes in composition as the battery is charged or discharged.

The active material, or "filling," which occupies the spaces in the plates, consists chiefly of lead oxide, lead sulphate, and spongy metallic lead. When the battery is entirely run down, the filling or paste that occupies the spaces or pockets of the positive plates has the same composition as that in the corresponding spaces of the negative plates,—each being then

composed mainly or wholly of lead sulphate. On the other hand, when the battery is charged to its utmost capacity the paste in the spaces of the positive plates consists almost wholly of lead peroxide, which is brownish or chocolate-colored, while that in the corresponding spaces of the negative plates is gray in color and consists of metallic lead in a porous or spongy form.

The plates of the battery are submerged in an acid solution (technically known as the "electrolyte"), which is composed of sulphuric acid and water. The strength of this solution varies according to the condition of the battery, the percentage to free acid being greatest when the battery is fully charged. To prepare an electrolyte solution having the composition that should then prevail, one volume of pure, concentrated sulphuric acid is mixed with two and one-half volumes of water; and the electrolyte, when thus prepared, is poured into the cell until the upper ends of the plates are submerged to the depth of about half an inch. To prevent leakage in handling, each cell is provided with a sealed cover through which the electrode terminals extend; and a removable filler cap in the cover provides a means of introducing the acid solution or electrolyte after the cover has been sealed in place.

The Battery in Action

Many persons take it for granted that a storage battery actually stores up electricity, but this is not the case. While the battery is being charged certain chemical changes occur in it, as will presentely be explained, and when the charging has been completed the battery has merely been brought into a condition in which it is capable of generating electricity until it runs down again,—that is, until the materials stored up in the spaces or pockets in the positive and negative plates have become chemically alike. It is chemical energy that is stored up in the battery, and not electricity.

To make this fact clearer, let us consider what happens when a fully-charged battery is brought into action, by establishing a complete electrical circuit from one pole of the battery to the other one, through the lamps of the car, or through the starting motor. We shall not go into the question of why a battery can produce an electric current, because that would take us a long way into the domain of theoretical physics. We shall merely begin with the known fact that batteries

do produce electric currents,—the liberation of electrical energy being attended by the simultaneous diminuation of the internal chemical energy that they contain.

It is important to observe that while the battery is discharging, the sulphuric acid in the electrolyte is becoming fixed at both sets of plates, through the formation of lead sulphate. In other words, the electrolyte becomes weaker and weaker as the discharge continues, and it is this fact that enables us to judge of the condition of the battery by determining the specific gravity of the electrolyte.

The chemical action here explained continues vigorously while the battery is in use as described, but it also proceeds (though much more slowly) when the battery is out of use and resting. The acid solution in an idle battery gradually diminishes in strength, and eventually the active material on the plates becomes transformed into lead sulphate, just as it would be if the battery had been discharging a current; and when this has occurred the battery will have become "dead."

To restore an exhausted battery to its useful condition, direct-current electricity is passed through it. This causes a reversal of the chemical action described above,—that is, the lead sulphate and water are broken up to form lead peroxide, sulphuric acid, and metallic lead. The sulphuric acid goes back into solution and the materials in the pockets of the plates or electrodes are restored to their original forms.

MAINTENANCE OF THE ELECTROLYTE

Heat is generated during the charging and discharging of the battery, and as a result some of the water in the electrolyte evaporates. A small quantity is also lost through electrolysis. Consequently, distilled water must be added from time to time to replace the water that is lost, and to keep the solution in the cells above the top of the electrodes, so that it may act upon the entire surface of the electrodes and thus assure the maximum output of the battery, and prevent deterioration of the plates.

The electrical equipment of most modern automobiles includes a direct-current generator which automatically keeps the battery fully charged under favorable conditions of car-operation. Under these circumstances, therefore, the battery requires little attention beyond that of adding distilled water, as previously explained, and testing the solution by means of

a hydrometer to see that the proper specific gravity is maintained.

The hydrometer usually employed for testing battery solutions is of a special type. It resembles a syringe in general appearance, and is operated by a rubber bulb. A glass tube is interposed between the bulb and the tip of the apparatus, and within this tube is a float consisting of a graduated glass cylinder, closed at both ends and weighted at the bottom so that it will remain in an upright position when the tube is filled with liquid. In using the hydrometer the tip or lower end of it is thrust into the electrolyte to be tested, and the bulb is squeezed. This forces a considerable quantity of air out of the bulb and tube, and when the pressure on the bulb is released a part of the electrolyte flows up into the hydrometer, partially filling the glass tube. The graduated float or cylinder rises at the same time, and presently comes to rest at a height determined by the specific gravity of the liquid, and the specific gravity is then ascertained by noting which of the divisions on the float stands at the same level as the surface of the electrolyte.

The "specific gravity" of a substance is its weight as compared with that of an equal volume of water. Thus, if a pint of water weighed just one pound, and we found that a pint of some other liquid weighed 1.834 pounds, we should say that the specific gravity of the second liquid is 1.834. To avoid the use of the decimal point the specific gravity of water is often called 1000 instead of 1.000, and in that case the specific gravity of the liquid we have just been considering would be 1834. This difference in usage does not occasion any confusion, because no known liquid is anywhere nearly a thousand times as dense as water, and when we see a density (or specific gravity) stated in four figures without any decimal point, we therefore know that it must refer to water taken as 1000.

We could determine the specific gravity of the electrolyte in the battery by weighing a known volume of it, and comparing the result with the weight of an equal volume of water; but the hydrometer enables us to make the comparison with far less trouble.

The makers of storage batteries usually recommend testing their batteries (and adding water if it is needed) once a week during the summer, and once in two weeks in the winter. We

believe, however, that it is better to make an examination oftener than this, because the level of the electrolyte sometimes goes down faster than the operator of the car realizes. This is specially true when touring, or when the car is in active service in any other way.

When inspecting the battery, make several hydrometer tests of the electrolyte in each cell. The normal specific gravity of the electrolyte in a fully charged cell is from 1.275 to 1.300, and it should be kept as nearly within this range as possible. If a number of successive tests show that that specific gravity of the electrolyte is considerably lower in one cell than it is in the others, it is probable that that particular cell is out of order and requires expert attention. If the specific gravity is low in all the cells, the battery doubtless needs charging. This may be done by means of the generator on the car by running the engine for a sufficient length of time with the car standing still; but in our opinion it is far better to remove the battery from the car and charge it from an independent source of electricity. If the specific gravity is above 1.31 an excessive charge is indicated, and the battery should be partially discharged by using the starting motor for a few minutes to turn over the engine with the ignition cut off, or by burning all the lights on the car for a time.

After having removed a specimen of electrolyte from a cell by means of the hydrometer, be sure to return the specimen to the cell from which it was taken. Otherwise there will be an excessive amount of acid in one cell and a correspondingly insufficient quantity in another.

After the specific gravity test has been made, note the level of the solution in the several cells, and, when needed, pour in sufficient *distilled* water, or filtered rain water, to entirely cover the electrodes. Be sure to use either distilled water or filtered rain water, because any other water, even though suitable for drinking purposes, is likely to contain mineral matter in solution, and this would be harmful to the battery. Don't add too much water, because the electrolyte expands when the battery is charging and is likely to overflow through the vent holes in the filler caps, and in such an event it will corrode the fittings and connections, and any other metal parts with which it may come in contact.

Car owners sometimes attempt to rejuvenate exhausted bat-

teries by adding acid. This is a grave error, and it is likely to result in serious damage to the plates. Adding more acid will increase the specific gravity of the electrolyte, but it should be remembered that the specific gravity of the battery solution is not the only thing to be considered. We measure it because it affords a useful means of judging the condition of the electrodes; but putting in more acid does not restore the material in the plates to the active state. If the battery is to work properly, the quantity of acid present must be kept within the range that the makers have found to be right; and it is not justifiable to add acid unless it is definitely known that some of the acid originally present has been lost by spilling or leakage. Even in a case of this kind it is far better to have the loss made good by an expert at a service station. Excess acid will cause permanent injury to the plates and separators, with the result that the active material in the grids will soften and fall out.

If the level of the solution in one cell is considerably lower than in the others, it is likely that the outer wall of the cell is cracked, and that the electrolyte is leaking away. In such a case a new cell will probably be required. It may be, however, that some of the solution has been spilled out, and in that event additional electrolyte must be supplied. As a general rule it is advisable (as we have already said) to have such work done at a service station, by a person who thoroughly understands the operation. If this is impracticable for any reason, the car owner can do the work himself, by mixing distilled water and pure sulphuric acid in the proper proportions, and filling up the cell with it, to the right level. It is important, however, to use the correct amount of acid, so that the cell will be restored as nearly as possible to its original state; and it is not always easy to determine just how much acid to add. Theoretically, the new electrolyte should have the exact specific gravity that prevailed in the cell at the time the spill occurred, because that would insure adding the same amount of acid that was lost. In practice, however, we may not know when the electrolyte was lost, nor what its specific gravity was at that time. A car owner who watches his battery carefully will usually be able to form a fairly good judgment on this point, however. He may know, from experience, that the specific gravity in the cell under consideration is usually about 1.275, for example; and in that event he may fairly assume that the new electrolyte should

have that density. The same principle applies, of course, if the usual specific gravity has some other value, such as 1.250 or 1.300,—the new electrolyte being made up, in any given case, to the specific gravity that usually prevails in the cell.

In preparing a new electrolyte solution by mixing sulphuric acid and water, always *pour the acid into the water* rather than the water into the acid, because the addition of a small quantity of water to a considerably larger quantity of acid (as would be the case at the start, of water were poured into a vessel containing acid) is likely to cause violent bubbling and spattering, which may result in injuries to the person performing the operation. In pouring acid into water, however, the proportionate quantities of the two liquids are reversed, and the chemical action that occurs is quieter and less dangerous. Even when the acid is poured into the water, however, it should be added slowly and in a thin stream, the solution being thoroughly stirred while the operation is going on. Considerable heat is developed when strong sulphuric acid is mixed with water, and therefore it is safest to add only part of the acid at a time, allowing the solution to cool down before more acid is poured in. The specific gravity of the mixture should be determined from time to time by means of the hydrometer,—the solution being at about 70° Fahr. when the measurement is made. After the specific gravity has been brought to the desired value, the new solution may be added to the cell. Do not pour it in, however, *until it has cooled.*

CHARGING, UNDERCHARGING AND OVERCHARGING

The manner in which an antomobile is operated has an important bearing upon the results obtained from the battery. For example, a physician who uses a car in making professional calls is likely to drive a comparatively short distance each day, but he will probably have to stop and start his engine many times. His services are also required after dark, and then, of course, his lights must be used,—perhaps for several hours. Under these conditions the amount of current drawn from the battery, for starting the car and running the lights, is likely to be considerably in excess of the amount replaced by the generator during the short periods when the car is operated, and therefore the battery is seldom fully charged. This con-

dition is often plainly evident from the reduced efficiency of the starting motor and the decreased light afforded by the lamps.

The case of the physician is cited in order to bring out, as clearly as possible, the points that we have in mind. A battery will always tend to run down when the car is operated in such a way that the output of electricity is unusually heavy in comparison with the supply from the generator. Undercharging may also be caused by short circuits in the wiring and connections between the generator and battery, or by derangement of the generator or of the current regulator, or in various other ways. Inspect all wiring and connections frequently, therefore, and keep the connections tight, clean, and free from corrosion, particularly at the battery terminals.

The car owner is sometimes responsible for failure for the battery to give the service demanded of it. He may substitute lamps of a higher candle-power than those furnished with the car, or may add a spot light, trouble light, extra lights for a winter body, a cigar lighter, and various other attachments which require electric current. In this way he may place an excessive load on the battery so that the generator in the car will be unable to keep it properly charged, even under normal conditions of operation.

Sometimes trouble attributed to the battery is in reality due to an improper adjustment of the generator. At a car speed of about fifteen miles an hour a properly adjusted generator should supply an amount of current somewhat exceeding that consumed by all the lamps included in the normal equipment of the car. Some generators provide an excess of 25 per cent. or more, at that speed. All excess current furnished by the generator goes to the battery and tends to maintain the battery in a fully-charged condition. In order that the generator may be kept in proper adjustment the car owner should learn the output of the generator and the amount of current required by the lamps. Both of these items may be determined by the use of the ammeter. This instrument is part of the regular equipment in practically all modern cars of high grade, and where none is provided by the car manufacturer, the owner should install one. The readings of the ammeter at different car speeds should be compared from time to time with the rating given by the manufacturer, and in case there is any import-

ant variation the cause of it should be determined and the proper remedy applied.

The ammeter should register zero when the engine is not running and the lights are all turned off. If it does not do so, the instrument itself may be out of order, and this manifestly *must* be the case if it indicates, under the assumed circumstances, that the battery is receiving a charge. If, on the other hand, the needle points to the "discharge" side, it is likely that a short circuit has been formed somewhere, and in that event the battery will run down rapidly, even when the car stands idle.

Be careful not to exhaust the battery by running the starter too long. In warm weather the engine ought to start easily, and if it does not do so the cause is probably not in the battery,—provided the starter turns the engine over vigorously. In cold weather the lubricating oil in the motor and other moving parts becomes thick and viscous, and the engine therefore turns over much harder and slower than when the weather is warm.

When a battery persistently shows a low charge, it should be examined at a service station, especially if no reason can be assigned for its apparent partial exhaustion. If the car has been used at night much more than usual, or if the starter has been operated with abnormal frequency, it is likely that recharging is all that is needed. The car owner should not experiment with the *generator*, under any circumstances. Brush adjustment, for example, should never be attempted except by a skilled man.

A partially exhausted battery may be recharged in appreciable measure by running the engine and generator in the car for two or three hours at a moderate speed. We strongly advise removing the battery, however, and charging it from an independent source of electricity, under suitable conditions. Do not undertake to charge your own battery from an external source of current, however, unless you know exactly what to do. You may ruin the battery if you connect it up the wrong way, or if you connect it to an alternating curcuit, or if you send too heavy a charging current through it. If you are going to do your own charging, provide yourself with the right kind of an outfit,—one that is appropriate to the circuit from which you are to take the electricity,—and find out pre-

cisely what the charging current should be, and be sure that you send the current through the battery in the right direction and at the proper rate.

If you take your battery out of the car for charging or for any other purpose, be sure to put it back again in exactly the same position that it occupied before removal,—connecting the cables to the same terminals to which they were originally attached.

A battery should *never be taken apart*, except by a man who is thoroughly familiar with this kind of work, and who has the proper facilities for doing it.

When a battery is being charged, a certain fraction of the water it contains is decomposed by the charging current, and oxygen and hydrogen gas are given off. These form an explosive mixture, and hence it is important to avoid bringing lighted matches or open flames of other kinds into the immediate vicinity of a battery that is being charged. Neglect of this precaution has caused serious accidents.

A condition which is directly the opposite of undercharging may be brought about by driving a car a long distance without using the starter or the lights. The battery is then likely to be overcharged, and it becomes excessively heated in consequence. The plates are then likely to buckle, and the active material in them may soften up and drop out. Therefore when taking a long journey in the summer it is advisable to carry a dairy thermometer, and to take the temperature of the battery once or twice a day. If the temperature rises to 100° Fahr. or more, all the lamps should be turned on while driving, even in the middle of the day. Do not be disturbed if every second man you meet calls your attention to the fact that your lights are burning. Keep them turned on just the same, unless your hydrometer indicates that the battery is becoming weakened; for if the temperature of the battery rises to 120° Fahr., the plates will probably be ruined. If you have no thermometer at hand, feel of the lead connectors on the top of the battery from time to time. This is a makeshift plan, but it is nevertheless helpful. If the connectors feel more than blood-warm, the battery is likely to become overheated.

A battery is sure to be ruined if it freezes. A fully charged battery will not freeze under any weather conditions that are likely to be experienced within the limits of the United

States,—except perhaps in the remote northwest; but when a battery stands idle it slowly discharges itself, as we have already explained, and even though it were safe from freezing at the outset, it may become discharged in the course of time to such a point that it will freeze and be destroyed. An electrolyte having a specific gravity of 1.260 freezes at about 60° Fahr. below zero, and one having a specific gravity of 1.160 (corresponding to about three-quarters discharge) freezes in the vicinity of zero. A fully discharged battery will freeze at about 20° above zero.

SUMMARY OF THE MORE IMPORTANT POINTS

1. Test the electrolyte with a hydrometer, *at least* once a week in summer and once in two weeks in winter, to see that the specific gravity is sufficiently high (not less than 1.270). Attend to this with special care in winter, even though it may be inconvenient to do so; because if the specific gravity gets too low the electrolyte may freeze, and the battery will then be ruined. When using the hydrometer, be sure to return the electrolyte, in every case, to the same cell from which it was taken. It is a good plan to make the test on Saturday or some other specially designated day, because the establishment of a routine of this kind tends to insure that the task will be performed and not forgotten. If the car is not to be used during the cold weather, it is a good plan to have the battery removed to a service station for storage. The charges made for this service are usually moderate, and the battery receives proper attention if it is taken to the right place.

2. If the battery electrolyte persistently shows a specific gravity less than (say) 1.260, have it fully charged at a service station. This may take two or three days, but you can usually hire a substitute battery for this period, at a moderate rental.

3. *After testing the electrolyte* for specific gravity, inspect each cell to determine if the plates are entirely covered with it. If they are not, fill the cells up to the proper level with *distilled water*. (This should be attended to faithfully even if the battery is not in use, unless it has been disassembled for storage.) Never fill the cells full, and never put in acid or anything else but distilled water or filtered rain water.

4. If any electrolyte has splashed out upon the exterior surface of the battery, wipe it off carefully with a cloth wet with

ammonia or with a solution of washing soda. Wipe off water from the top of the battery, also. Don't leave anything lying on the battery;—a tool laid down there, for example, is quite likely to make a short circuit.

5. Keep the battery terminals clean and bright where the wires are attached to them, and be sure the connections are tight. Corrosion is usually indicated by the presence of a solid deposit which is often (though not always) hard and greenish, and it is likely to reduce or entirely prevent the flow of current. Coating the terminals with a thin film of vaseline or grease is helpful in preventing corrosion.

6. Be sure to keep the filler caps tightly in place, to prevent spilling the solution and to keep out dirt, oil, and other foreign matter.

7. Keep the battery box clean and dry, and see that the battery is held firmly in position (it should preferably be bolted down), so that it cannot be thrown about by the motion of the car, and also to prevent spilling the electrolyte. It is essential that air should be allowed to circulate freely about the battery, and therefore the space between the battery and the box that contains it should not be filled with tightly-packed cotton-waste or other material. The battery should be held in position by some other means. Packing the space around it promotes overheating.

8. Do not allow the battery to become heated to a higher temperature than from 100° to 110° Fahr. This is exceedingly important, and it means that when touring during the hot weather of summer, the battery should be examined several times a day. If there is evidence of a tendency toward undue heating, burn all the lights as recommended in the text, above.

9. Follow the instructions of the manufacturers of the battery. If you are uncertain about the proper procedure, or if leakage is observed or any unusual trouble develops, go to a service station and have the battery attended to by an expert.

Magnets: What the Staff of Magnes Found

JUSTIN W. MCEACHREN

Magnes was a shepherd of Crete. Like all Greeks—even Greek peasants—he was something of a philosopher and considerable of a dreamer. As he watched his flocks on the slopes of Mount Ida he thought of the infant Jupiter and wondered if the Corybantes had tended the young god on the very spot where he then was sitting. Then he singled out the best-favored goat in his flock and wondered if it would prove worthy to be a second Amalthea, should another baby deity come to Mount Ida to be suckled.

Being unable to reach any satisfactory conclusions to all his fancyings, Magnes leaned his iron-tipped crook against a convenient rock, disposed himself comportably upon the greensward, and fell fast asleep.

When he awoke the sun dipping beneath the waters of the Egean, and his flocks had wandered beyond his range of vision. Hastily springing to his feet he grasped his crook. Then he noticed a most surprising and unheard-of thing. The iron tip of his staff did not want to leave the rock. The rest of the staff, being wood, was as willing as usual to go with Magnes, but the iron rebelled. The shepherd gave a strong pull and the point left the rock. Then he felt for some sticky substance that might account for the phenomenon, but his hand touched only smooth and unadhesive stone. The wooden crook of his staff would not stick to the stone. Again he touched the iron tip to the rock, and again it took a sharp pull to free it.

DERIVATION OF MAGNET

Forgetting his flocks and his dreams, Magnes ran and told some philosophers of the strange thing he had seen. These wise men hastened up the mountain and after experimenting they found that the mysterious stone had a powerful affinity for iron, and that a piece of this metal, rubbed on the rock, was given the power to attract other metals and to hold them to itself. They called the stone Magnes, in honor of the shepherd. From this has come our word magnet.

This is the Greek story of the discovery of loadstone, which later led to the invention of the mariner's compass.

But the weak point of the Greek story is that it relates to matters about 2,500 years too late in the world's history to touch the first discovery of loadstone and its adaptation to guiding travelers both on land and sea. We must once more go back to China to find this. Here is the earliest notice of the magnetic compass, and it comes from China.

Tchiyeou and the emperor, Tau-ti-yu-wang, were at war. Tchiyeou was a very harassing enemy, because he was without scruple and had contrived a variety of fighting implements that gave his soldiers a decided advantage over the royal troops. After a number of petty engagements in which the emperor gained little glory, Tau-ti-yu-wang mustered all his men and prepared for a final and decisive conflict.

THE FIRST "POISON GAS"

The two armies faced each other on a plain, and the emperor gave the command to advance. But Tchiyeou caused the plain to be covered with a heavy mist so the royal troops not only could not see but became hopelessly entangled among themselves. (It would seem as though we have here the first instance in history of the use of "poison gas," or at least of chemical fumes of some sort, in warfare.)

Then the Emperor Tau-ti-yu-wang caused a chariot to be made, on which the wooden figure of a man pointed his right arm constantly toward the south. With the aid of this chariot the emperor led his cohorts through the mist and found and vanquished the troops of the troublesome Tchiyeou.

The figure on the chariot was magnetized and it pointed steadily to a great mountain of loadstone, supposed to be some where in the sea to the south of Asia. This incident bears date 2,634 years before Christ, or some three centuries before Noah set out on his memorable voyage, to drift forty days and forty nights on a trackless sea without the aid of a mariner's compass. But perhaps this conclusion is hasty. The ark may have been guided by a compass for all we know to the contrary.

It is not known when the loadstone's most important property—polarity—was discovered, but it undoubtedly was familiar to the Chinese previous to the chariot incident just related. They seemed to have knowledge of this property, for they were confident in following cardinal points designated by the arm pointing south. They believed an iron figure so magnetized always would point to a place south of their own country.

CHINESE MAGNETIC CHARIOTS

Humboldt allows that the Chinese knew of the polar properties of loadstone at least a thousand years before our era, and he describes magnetic chariots that were used to guide travelers across the great plains of Tartary. He also says that as early as the third century, A. D., they used the compass for guiding vessels at sea. From the Chinese the Arabs in all probability learned to use the magnetic needle, and in this roundabout fashion it was brought to Europe.

Flavio Gioio, of Amalphi, Italy, improved the Arabs' compass in 1300 by suspending the needle, and for this he is given credit generally for inventing the mariner's compass. But this contention must give way after even a casual investigation of the subject. He simply substituted a carefully balanced needle for one floating on pieces of cork or straw in a vessel of water.

A Chinese encyclopedia of 700 B. C. gives a very good description of the compass, written in such a way as to preclude all doubt that the contrivance long had been known to the Chinese at that date. Those who have read the "Arabian Nights" will recall what befell Sinbad the Sailor when his ship got too near the mountain of loadstone and all the nails were drawn from the planks, leaving the wrecked boat to the mercy of the waves. Ptolmey also speaks of a great magnetic mountain in the Chinese seas, and says it drew ships toward it unless they were made without iron and carried no iron aboard. Loadstone and its properties were known to Hesiod and Aristotle, and Pliny mentions it, saying that ignorant persons called it "ferrum vivum"—quick iron.

EARLY DESCRIPTION OF THE COMPASS

There is a curious passage in one of Cardinal de Vitry's writings. He visited Palestine in the thirteenth century, and thus speaks of what we today know as the mariner's compass: "The iron needle after contact with the loadstone, constantly turns to the north star, which, as the axis of the firmament, remains immovable, whilst the others revolve; and hence it is essentially necessary to those navigating the ocean." What a remarkable comment is this. How near de Vitry came to the great truth enunciated some two centuries later by Galileo. If he only had reasoned from Polaris to the earth he might have become immortal by saying: "It moves." But at any rate he described

the mariner's compass as exactly as it may be described today, so far at least as essentials are concerned.

The first mention of the compass by an English observer was in the twelfth century where it is spoken of in certain records of Alexander Neckham. The good ship "Plenty" sailed from Hull in 1338 "steered by a sailstone." She was the first English vessel to sail by the compass.

Columbus is credited with having been the first to notice the variation of the needle and he tells how much worry the discovery caused him. But the Chinese had knowledge of this annoying vacillation as early as 1111 A. D.

So, touch what point we may in the modern development of this most useful impressment of natural laws to the comfort, convenience, and safety of man, we are compelled to doff our caps and yield prior claims to the sons of the Celestial Empire. The iron tip of the staff of Magnes pointed westward as it clung to the rock on Mount Ida, and following this direction twelve years after the magnetic needle was used in guiding European ships, Columbus trod the Bahamas as a prelude to his feet touching a larger, broader and infinitely grander shore a year or so later. So also had Diaz doubled the Cape of Storms and Da Gama had found his course to the East Indies. Today the Staff of Magnes is the magic wand that unerringly guides a world's commerce upon the seven seas.

THE VALVE WORLD, November 1921.

The Value of Junk

Finding gold at the end of a rainbow is a thoroughly practical way to get wealthy, provided the rainbow happens to end in a junk-heap. Manufacturers of metal products are finding gold valued at millions of dollars in such heaps. The *Mining Congress Journal* of Washington points out that more than $200,000,000 was recovered from junk heaps and metal scraps in 1910. It quotes the U. S. Geological Survey to the effect that secondary metals were recovered from scrap, sweepings, skimmings and drosses to the value of $181,841,500. The figure for 1918 was $264,298,900. Gold, silver, platinum, iron, steel and ferro-alloys are not included.

Motion Picture Films in Geography and Science

LISTS PREPARED BY THE NATIONAL BOARD OF REVIEW

254 Films on North American Geography, History, Peoples, Selected Industries.

367 Films on World Geography (exclusive of No. America): West Indies (7), South America (24), Europe (154), Africa (40), Asia, including Palestine (78), Pacific Islands (39) Peoples of the World (25).

233 Films on Zoology (155), Biology (52), and Botany (26).

These lists make no attempt to cover the fields described. Little organized work has been done by educators in producing acceptable motion pictures. The films have not been made primarily for school boys and girls; rather have they been prepared for the entertainment of adults in theatres. Many of them lack the proper organization of the material introduced and fail to exclude subjects which are extraneous and confusing. They simply blaze the way into regions which require more careful study.

The place of instructional pictures in the curriculum of the secondary schools is distinctly that of the handmaid; it is supplemental to the systems of instruction worked out by generations of educators. The film has the power to make unusual and far removed or intricate subjects, natural and clear to the developing mind of the child. Even the casual student of the subject perceives that the motion picture in no sense minimizes the value of books, of the teacher, of language and of oral recitation. The film opens up larger regions about which the teacher may give instruction and makes possible the more intensive use of books and of actual visual material.

Some of the terms used in the classroom are almost unintelligible to boys and girls. The use of the dictionary helps somewhat. But even with its aid the children are unable to create accurate and interesting mental pictures. Few children, for example, can visualize the content of such terms as copra, coffee plants, cotton growing and ginning, sugar making, copper, iron or coal mining, ranches, tribal life in Africa, ocean commerce, etc. The motion picture carries the child to the region in question and shows the place or the process in natural surroundings to which is added the element of motion.

The ordinary instructional picture deals without pretense with the obvious, the superficial and the outstanding facts which attract attention. When once these facts are grasped, the mind more easily permits of reasoning from cause to effect or from effect to cause. It is doubltful if there is such a thing as eye mindedness. The eye has always played a very large part in education as the exciting stimulus to thought and to reason.

There are certain elements differing with individual boys and girls that are necessary to capture the attention and to urge the mind to more fundamental research. These elements are sometimes obscure to the adult mind which has long past these preliminary stages, and they sometimes appear of little consequence. The one thing necessary may be the element of color or movement as in the study of birds, butterflies, and moths. Again, it may be the peculiarity of form as in the case of the palm tree with its cluster of dates or cocoanuts. It may be the awkwardness of the camel or the spouting of the whale. Again, it may be some unusual detail of family life or industrial life or the dress and garb of a person of another race.

Interest in all these is aroused by the element of action presented in the motion pictures, and this interest usually stimulates mental

processes. It is in this field of the unusual, the intricate, and the bizarre, that the motion picture makes its contribution in certain phases of education which are slowly being defined.

In all such motion pictures the appeal is primarily instructional through arousing interest. The requirements for teachers are inevitably enlarged and broadened. They must know their subjects as human and full of life or they are unable to build broad and deep on the superficial interests aroused. They must be quick to note the handle to knowledge grasped by the children or indicate it to them as the film passes in review. They must know enough of the life and work of the peoples of the world to round out the picture accurately and impressively.

No blame can be attached to the motion picture film for failure to enlarge and beautify the picture on the part of the teachers. The motion picture now exists as a wonderful stimulator of interest in certain fields of historical, commercial, industrial, anthropological, physical and astronomical geography. It is entirely up to the teacher as to the extent and value of its usage.

There is a distinctive problem of another sort involved in the making and the use of the dramatic picture for teaching purposes. It is unquestionably a powerful medium but it is decidedly limited by the rules of drama. It often develops into a biased interpretation of historical events by the maker, who wrenches these facts for the sake of his story. In the dramatization of history, literature, the novel and poetry, the value of the motion picture for education is decidedly secondary. Occasionally, a drama is made which causes standard literature to live anew in the minds of boys and girls; but inevitably, because the medium is the obvious, the seen, and the moving, the picture drops out many things which enrich the mind through the written word.

The film in the school comes as a welcome relief to classroom instruction. It is, moreover, welcomed by children under the influence of the school atmosphere and discipline as it would never be by the same group in the theatre. Even children go to the motion picture theatre to be amused. They resent education there as they welcome it in the school room. Even little children discover rapidly that they go to school to learn and that for four or five hours a day they are expected to conform willingly and completely to the school spirit. There is no rebellion against instructional films by the children. On the contrary, there is a welcome. The teacher who knows and loves her subject will find in the motion picture an opportunity for intensifying and for beautifying text book and the classroom work.

MORE DEFINITE FACTS ABOUT THESE LISTS

They are prepared by the people interested primarily in education.

They are designed for the needs of teachers and educators of visual instruction.

An attempt has been made to include only films lately produced and now in circulation and rented in large sections of the country. The material is far from perfect from an educational standpoint, both as to method of presentation and as to organization of fact, but it is the best material available. The National Board is not interested in producing, buying, selling, renting or distributing films. It desires to assist users in finding *all* available films, and in renting them in the cheapest and most effective way. The charge of 25c for each list is made to meet a part of the cost of gathering material, of printing and of circulation. They may be had by writing the NATIONAL BOARD OF REVIEW, at 70 Fifth Avenue, New York City. Following are given a few titles selected from the lists mentioned above:

GEOGRAPHY—HISTORY, PEOPLES, INDUSTRIES

Titles	Reels	Remarks	Company
Lure of the Maine	1		Carter Cinema
Quaint Provincetown on Cape Cod	½	Life and Customs	George Kleine
Down Town New York	½	New York City	Pathe Review No. 85
My Adirondack Outing	½	Nature and Geography	Kineto Review
In and Around Key West	1	Customs, Cigar Industry	Universal Film Corp.
Land of the Bartlett Pear	½	South Texas	Pathe Review No. 21
First American Apartment House	½	New Mexico Cliff Dwellers	Educational Films Corp.
Through the Nation's Parks	1	Yellowstone, Yosemite, Glacier	Educational Films Corp.
Gypsy Scientists	1	Scenery, Animals	Bray-Goldwyn
From Blossom to Blooms	½	California	Pathe Review No. 28
Alaska Wonders in Motion	4	Mining, Railroads, People	Educational Films Corp.
Valley of Ten Thousand Smokes	1	Alaska, Volcanoes	Educational Films Corp.
What the Ice Age Left	1	Topographical Changes	Educational Films Corp.
Story of Plymouth Rock	1		George Kleine
Panama Canal: Economic Significance	1		Society for Visual Education
Conservation, Reclaiming Arid Land	1		Society for Visual Education
Across the Rocks to the Pacific	1		Society for Visual Education
King's Spruce	6	Lumber Camp Drama	Pathe
Iron Heart	5	Iron Industry	Fox
Story of a Grain of Wheat	1		Educational Films Corp.
Lumbering Yellow Pine in the Southwest	1		U. S. Dept. of Agr.
Making a Ford	2		Ford Motor Company, Detroit, Michigan
Manufacture of Rubber Goods	Multiple		Firestone Tire & Rubber Co., Mich.
Cement	"		Portland Cement Ass'n., Chicago
Story of Coal	3		U. S. Bureau of Mines
Sanitary and Scientific Dairying	2		Borden Milk Co., 108 Hudson St., New York City
Make of Bread	3		Ward Bread Co., N. Y. C.
Story of Oil	12		Standard Oil Co., N. Y. C.
Pulp Paper Industry	2		W. G. Sonders Co. Chicago
From Cocoon to Spool	2		Corticelli Silk Mills, Florence, Mass. Company
Under Cuban Skies	1	Havana and Harbor	Famous Players, Laska (B. Holmes)
Outing in Brazil	½	Coast Life Cities	Kineto
Seeing Sights in London	1	England	Famous Players, Laska (B. Holmes)
Marseilles	—	Ancient Streets, People	Red Cross No. 109
In New Madrid	1	Spain	Famous Players, Laska
Switzerland	½	Color	Pathe Review No. 19
A Trip through Bosnia, Austria	1	Balkan Saragevo	New Era
Russia, A World Problem	1	Commission across Russia	Red Cross No. 111
Sugar in the Making	½	Java	Pathe Review No. 8
Red Hot Sea	½	Hawaii, Kilauea	Educational Film

ZOOLOGY, BIOLOGY AND BOTANY

Titles	Reels	Remarks	Company
Educated Monkey	½	Ditmar's	Pathe Review No. 13
Owners of Fur	½	Ditmar's	Pathe Review No. 16
American Bears	½	Grizzly, Cinnamon, Kodiak	Educational Film
Thorough Bred Horses in Kentucky	½		Kineto Review No. 14
A Day in Dogdom	1		Industrial Dept. of Y. M. C. A.
Wichita National Forest	3		U. S. Dept. Agri.
Raising Ostriches in South Africa	½	Life history	George Kline
Babies of the Farm	½	Ditmar's bugs, birds, kittens	Educational Film
Surgery at the Zoo	½	Python changing skin	Educational Film
Call from the Wild	5	Romantic dog story	Pacific
Black Beauty	7	Story of a horse	Vitagraph
Insect Oddities	½	Color	Pathe Review No. 19
Insect Artists (Spider)	½	Color	Pathe Review No. 95
Getting Acquainted with the Bees	1	Life and habits	George Kline
The World to an Ant	½		Educational Film
Animals of the Garden	½	Bugs, toads, etc.	Educational Film
Life of a Moth	½	Ditmar5s	Educational Film
The Monarch Butterfly	1	Nature Study	Society for Visual Education
Microscopic Pond Life	½	Animal and plant water life	George Kline
A Day with John Burroughs	1		Prizma
Magic of Summer	½		Pathe Review No. 57
The Western Cantaloupe Industry	½	Ditmar's	U. S. Department of Agriculture
In a Naturalist Garden	½		Educational Film
Luther Burbank	1		Industrial Department of Y. M. C. A.

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PATHE EXCHANGE INC., 35 West 45 Street, New York City.

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GOLDWYN PICTURE CORP., (BRAY) 469 Fifth Avenue, New York City.

FEDERATED FILM EXCHANGES (FORD), 220 West 42 St., New York City.

FAMOUS PLAYERS LASKY CORP., 485 Fifth Avenue, New York City.

VITAGRAPH COMPANY OF AMERICA, 469 Fifth Avenue, New York City.

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GEORGE KLEINE, 116 S. Michigan Av., Chicago, Ill.. also 145 West 45 Street, New York City.

PRIZMA INC., 71 West 23 Street, N. Y. C. (Releases also thru Select & Republic).

SOCIETY FOR VISUAL EDUCATION, 806 W. Washington Blvd., Chicago, Ill.,—also 220 West 42 Street, New York City.

U. S. DEPT. OF AGRICULTURE, FILM BUREAU, Washington, D. C.

ARGONAUT FILM COMPANY, 45 West 18 Street, New York City.

NON-THEATRICAL M. P. (Released through Harry Levy Inc., 1664 Bway, N. Y. C.

PACIFIC FILM CO., care of PRODUCERS SECURITY, ATT. MR. HANCOCK, 516 5 Av., N. Y. C.

Book Reviews

Laboratory Projects in Physics.—F. F. Good. 267 pages—104 cuts—The Macmillan Company.

Here will be found 95 experiments on every day physics topics, treated according to modern approved methods. The book might well form the basis for a high school course in physics where college entrance requirements are not a barrier. And in any school, pupils in general science will find it extremely suggestive and helpful in working out some of their projects. Excellent thought-stimulating questions accompany each experiment. Books for further study in each subject are listed and a complete list of apparatus with prices is given in the appendix.

A General Course in General Chemistry—Second Edition—McPherson and Henderson—737 pages—176 illustrations—Price $3—Ginn and Company.

This edition is a revision of the earlier popular chemistry text by the same authors. Considerable new material is found particularly with reference to the great advances and innovations brought about in the field of chemistry by the World War. The discussions of theories and descriptions of modern industrial processes are two strong features of the book. The text is for the college student who can hardly fail to be impressed with the possibilities of chemistry.

The Teaching of General Science in the High School—Helen R. Houck—27 pages—Volume 3,—No. 7,—Maryland School Bulletin. 25c.

The Teaching of High School Chemistry—Agnes Bandel—24 pages—Volume 3,—No. 8,—Maryland School Bulletin.

The Teaching of High School Physics—Lillian Creighton—25 pages Volume 3,—No. 9,—Maryland School Bulletin.

The Teaching of High School Biology—Amelia H. Fritz—20 pages—Volume 3,—No. 10,—Maryland School Bulletin.

These four numbers on science teaching were prepared under the direction of Mr. Samuel M. North, State Supervisor of High Schools. They are issued by the State Department of Education at Baltimore. The series makes a complete, unified science course for the high school, thoroughly in accord with the recommendations of the Commission Reorganization of Secondary Education. The pamphlets give aims, methods, suggestive lessons, book lists and laboratory equipment needed. Altogether these pamphlets make one of the best science series for a high school that we have had the good fortune to see.

A Manual for General Science in the Ninth Grade—Prepared by a Committee of Cleveland Teachers with Ellis C. Persing, Chairman.—Published by the Board of Education.—Price 25c.

This fifteen page manual gives aims and method of conducting general science courses. It suggests equipment for the general science room. There is an outline of main topics or units of study under which it suggests topics, projects, demonstrations, and gives specific references for book study. It is a very suggestive and helpful manual.

The Chemical History of a Candle—Michael Faraday—Edited by W. R. Fielding—158 pages—price 70c—E. P. Dutton & Company.

Though this series of lectures was given to audiences of young people three quarters of a century ago they are just as suitable for the children of today. A reading and use of this book will help many teachers to acquire something of the method of that master of science in teaching science to the young. The experiments illustrated and described are peculiarly adapted to use in general science classes. Besides Faraday's *Lectures* the book contains an account of Faraday by J. A. Thomson, an introduction by Sir William Crooks and a short chapter by Professor Tyndall on Faraday. It is a small book but well worth the price.

Vitamines—Benjamin Harrow—219 pages—$2.50—E. P. Dutton & Company.

"Vitamines" is a book giving an account of the marked advance in modern nutrition. It is interesting from beginning to end. Five chapters deal with the more common and better known food constituents. A long chapter is devoted to amino-acids, one chapter to glycogen and one to soap and glycerine. Then the rest of the book (about one hundred pages) discusses vitamines, the discovery of vitamine, the different vitamines, their properties, the relation of vitamines to various diseases and many feeding experiments are discussed in detail. The final chapter is a summary with practical applications. Two valuable tables are found in the appendix showing the percent of amino-acids from various proteins and the distribution of the three accessory factors of vitamines in common foods.

Science Articles in Current Periodicals

AERONAUTICS

America's largest aerial battleship, ill. P. J. Risdon. Pop. Sci. Mo. 99:3:24-26. Sept. 1921.

Showing a main airport in operation. Fletcher Allen. Cur. Opin. 60:827. June 1921.

The greatest aerial disaster. Lit. Dig. 70:10:13. Sept 3, 1921.

Bending strength of "ZR-2.' Sci. Am. 125:178. Sept. 10, 1921.

Flying castles in the air. L. L. T. Driggs. Cur. Opin. 71:294-299. Sept. 1921.

AGRICULTURE

Protecting the U. S. from plant pests, ill. Charles L. Marlatt. Nat. Geog. Mag. 40:205-218. Aug. 1921.

Pruning. ill. F. L. Mulford. Am. For. 27:390-391. June 1921.

ANIMAL LIFE

Wild life of Lake Superior, ill. Geo. Shiras, 3rd. Nat. Geog. Mag. 40:113-204. Aug. 1921.

Life in ponds and marshes, ill. R. W. Shufeldt. Am. For. 27:299-306. May 1921.

ASTRONOMY

Model of the solar system. Isabel A. Lewis. Sci. & Inv. 9:331. Aug. 1921.

Clusters and nebulae. J. F. Springer. Sci. Am. 125:46. July 16, 1921.

The craters of the moon, ill. J. F. Springer. Sci. Am. 124:490. June 18, 1921.

ATOMS

What happens when a planetary electron escapes. Cur. Opin. 71:92. July 1921.

AURORA BOREALIS

What is the aurora borealis? Sci. Am. 125:67. July 23, 1921.

BAROMETERS

How a barograph can be used in business. J. E. Hogg. Pop. Sci. Mo. 99:1:27. July 1921.

BIOLOGY

How the lower animals see. Wm. Crowder. Sci. Am. 124:509. June 25, 1921.

THE BRAIN

Man's thinking mechanism. L. A. Housman. Ill. World. 35: 831. July 1921.

BRIDGES

The New York approach to the Hudson River bridge. ill. Sci. Am. 124:508. June 25, 1921.

CAMP

Camp sites along western highways. A. G. Vestal. Ill. World. 35:801. July 1921.

Trails to the great out doors. ill. A. H. Cahart. Am. For. 27:281-290. May 1921.

Vacation land. ill. Am. For. 27:383-388. June 1921.

Our National parks and how to reach them. ill. A. E. Demaray. Am. For. 27:360-370. June 1921.

CANALS

Canada's great ship canal. J. F. Springer. Sci. Am. 124:504. June 25, 1921.

CLIMATE

What is the best climate? Lit. Dig. 70:10:27. Sept. 3, 1921.

COOKING

Use of the pressure cooker in the home. M. C. Denton. Jo. Home Econ. 13:361-366. Aug. 1921.

DIAMONDS

How to test. Pop. Sci. Mon. 99:1:42. July 1921.

DISEASE

Stamping out hydrophobia in Chicago. R. H. Moulton. Pop. Mech. 36:359. Sept. 1921.

DIVINING ROD

The divining rod made respectable. E. F. Cone. Sci. Am. 125: 219. Sept. 24, 1921.

The divining rod. Sci. Am. 125:214. Sept. 24, 1921.

DRYING

Vacuum drying. Lavett and Van Marle. Jo. Ind. and Eng. Chem. 13:600. July 1921.

EINSTEIN THEORIES

Planetary motions and the Einstein theories. C. L. Poor. Sci. Am. Mo. 3:484. June 1921.

ELECTRICITY

Equip your house with the bell-ringing transformer. H. H. Parker. Pop. Sci. Mo. 99:3:81. Sept. 1921.

How electric shocks kill? Pop. Sci. Mo. 99:3:70. Sept. 1921.

Curing disease with ultra-violet light rays. P. Schwarzbach. Pop. Sci. Mo. 99:1:15. July 1921.

FLOWERS

Wild flowers: Springtime in the woods. ill. A. B. Klugh. Am. For. 27:317-319. May 1921.

FOOD

Food under the microscope. ill. L. A. Hausman. Sci. Am. Mo. 3:513. June 1921.

Searching the world for new food plants. Sci. Am. Mo. 3:516. June 1921.

FORESTRY

Forestry from the air. ill. Stanley Frost. Am. For. 27:278-281.

Reforestration in the middle states. W. E. Hayes. Am. For. 27:376-378. June 1921.

FIRE PREVENTION

The obligation of the city to its citizens. A. T. Fleming. Amer. City. 24:603-606. June 1921.

FISHING

Life on the Grand Banks. ill. Frederick W. Wallace. Nat. Geog. Mag. 40:1-28. July 1921.

FOUNTAIN PEN

Inventions that have earned wealth. C. F. Carter. Sci. and Inv. 9:321. Aug. 1921.

GRASS

Familiar grasses and their flowers. ill. in color. E. J. Geske and W. J. Showalter. Nat. Geog. Mag. 39:625-636. June 1921.

HAY FEVER

Hay fever; its cause and cure. ill. Earnest Bade. Sci. and Inv. 9:212. July 1921.

The summer sneezer. F. P. Stockbridge. Sci. Am. 125:45. July 16, 1921.

HYGIENE

Testing the human machine in the man-testing laboratory. ill. Sci. Am. 125:187. Sept. 10, 1921.

Chemical war on disease. H. Schwarz. Sci. Am. Mo. 3:503-506. June 1921.

HYGIENE

Vaccines and Serums. ill. D. McClure. Sci. Am. Mo. 3:507-511. June 1921.

The school nurse—her duties and methods. Percye Powers. Am. City 25:190-192. Sept. 1921.

Probing Metabolism. Cur. Opin. 71:345. Sept. 1921.

IRRIGATION

Irrigation ditches cause stupendous loss. L. W. Pedrose. Pop. Mech. 36:275. Aug. 1921.

LANDSCAPE GARDENING

Planting the pool in nature's manner. ill. Robert Wheelwright. Gar. Mag. 33:354. Aug. 1921.

Garden plants for quick effect. ill. Norman K. Morse. Gar. Mag. 33:369. August 1921.

LEONADO DA VINCI

Natural philosopher and engineer. ill. John W. Lieb. Jo. Fr. Inst. 192:47-68. July 1921.

LIGHTNING

"Black lightning." ill. F. Ellerman. Sci. and Inv. 9:322-23. Aug. 1921.

The power of lightning. ill. A. H. Scott. Sci. and Inv. 9:210. July 1921.

MEASURING

Measuring one five hundred millionth of an inch. Briggs and Yates. Pop. Sci. Mo. 99:1:64. July 1921.

MOTHS

The most wonderful of all moths. Cur. Opin. 71:88. July 1921.

NATIONAL PARKS

Your national parks. Stephen T. Mather. Am. For. 27:342. June 1921.

Unfamiliar scenes in national parks. ill. H. W. Gleason. Am. For. 27:343-355. June 1921.

Stephen T. Mather: the man who did it. Am. For. 27:356-359. June 1921.

NUTRITION

Chemical factors in nutrition. L. B. Mendel. Jo. Fr. Inst. 192: 1-10. July 1921.

PEARLS

Artificial pearls. ill. T. A. Marchmay. Sci. Am. Mo. 533. June 1921.

PHOTOGRAPHY

How to take pictures. H. A. Hartman. Ill. World. 35:871. July 1921.

PIANO

How your piano is made. H. F. Summerhays. Ill. World. 35: 845. July 1921.

PLATINUM

A great adventure in platinum. Cur. Opin. 71:112. July 1921.

POWER

Generating electricity from the wind. Cur. Opin. 71:119. July 1921.

PRECIOUS STONES

Man-made precious stones. ill. C. M. Lewis. Sci. Am. 125:48. July 16, 1921.

RADIUM

Radium's role as a life saver in industry. A. H. Powers. Ill. World. 35:819. July 1921.

ROADS

The Pacific Highway and its "Peace Portal"... ill. R. C. Johnson. Rev. of Rev. 64:77-80. July 1921.

Dust prevention on gravel roads. Ill. G. C. Dillman. Am. City. 25:9-12. July 1921.

The Lincoln Highway of today. ill. Am. City. 25:106. Aug.

SOAP

True nature of soap solutions. Sci. Am. Mo. 3:538. June 1921.

SNAKES

Snake lore. ill. R. W. Shufeldt. Am. For. 27:445. July 1921.

SOUND

Experimental phonetics. Ill. May Tevis. Sci. Am. Mo. 3:527. June 1921.

TRAFFIC

Traffic street plans—Portland, Ore. C. H. Cheney. Am. City. 25:47. July 1921.

TRANSPORTATION

Coming to the "trollibus." Lit. Dig. 70:6:24. Aug. 6, 1921.

TREES

Oaks for ornamental planting. ill. F. L. Mulford. Am. For. 27:461. July 1921.

The tree as a living thing. Cur. Opin. 70:811. June 1921.

How school children study trees. ill. Susan S. Alburtis. Am. For. 27:291-298. May 1921.

WATER-SUPPLY

Modern methods of water supply and purification. M. F. Sanborn. Am. City. 25:25-28. Aug. 1921.

What makes water "taste? Pop. Sci. Mo. 99:2:28. Aug. 1921. 1921.

WEATHER

What "Cloudbursts" are. Lit. Dig. 69:13:21. June 25, 1921.

WOOD

Uses of wood in games and sports. ill. Hu Maxwell. Am. For. 27:431. July 1921.

X-RAY

Behavior of a Roentgen meal in the human stomach. Cur. Opin. 71:90. July.

No danger in being X-rayed. Lit. Dig. 70:3:23. July16, 1921.

Magazine List

American City. The Tribune Building, N. Y. C. Monthly. $4.00 a year, 50c a copy. The science problems of city and rural communities are treated in numerous articles, well illustrated. A valuable student and teacher reference.

American Forestry. Washington, D. C. Monthly. 30c a copy, $3.00 a year. Splendid pictures for plant and tree study.

Commercial America. Phila. Com'l Museum, Phila., Pa., $2.00 a year. Ill. Commercial production. New Inventions. Will interest Commercial geography and science teachers.

Current Opinion. 65 W. 36 St., N. Y. Monthly. 35c a copy, $4.00 a year. Has a regular department "Science and Discovery" containing articles of popular interest, adapted to pupil or teacher's use.

Country Life, The New. Garden City, N. Y. Monthly. 50c a copy, $5.00 a year. Stands at the head of publications dealing with life in the country. Special interest to the general reader and has many articles on gardening and plant study valuable for school use.

Everyday Engineering Magazine. 33 W. 42 St., N. Y. Monthly. 20c a copy. $2.00 a year. Ill. Popular articles on science and mechanics. Much of it is simple enough for elementary pupils.

Experimental Science. 1311 G St. Washington, D. C...Monthly...15c a copy, $1.50 a year. An interesting boys' magazine. Strong on wireless.

Garden Magazine. Garden City, N. Y. Monthly. 25c a copy, $3.00 a year. Ill. Helpful to amateur gardeners, teachers and pupils.

General Science Quarterly. Salem, Mass. Quarterly. 40c a copy, $1.50 a year. The only journal published devoted alone to science in the elementary and secondary schools. It tells what schools are doing in science, gives lesson plans, demonstrations, and an extensive bibliography of usable articles in current periodicals.

The Geographical Review. Broadway at 156th St., N. Y. $1.25 a copy $5.00 a year. Devoted to scientific geography. Original maps and pictures. One department contains condensed items of topics of current interest.

The Guide to Nature. Sound Beach, Conn. Monthly. 15c a copy, $1.50 a year. Ill. Of interest to elementary pupils and teachers of nature study.

Illustrated World. Drexel Ave. and 58th St., Chicago. Monthly. 25c a copy, $3.00 a year. Many short articles on applications of science and mechanics. Popular in style and attractive to elementary and high school pupils.

Journal of the Franklin Institute. Philadelphia, Pa. Monthly. 50c a copy, $5.00 a year. Ill. A technical journal. Contains many articles of value to science teachers.

Journal of Home Economics. 1121 Cathedral St., Baltimore. Monthly. 25c a copy, $2.00 a year. For teachers.

The Literary Digest. 354 Fourth Ave., N. Y. Weekly. 10c a copy, $4.00 a year. Has a department "Science and Invention." Articles are mostly digests from other journals. They are popular in nature and suitable for high school pupils.

Journal of Industrial and Engineering Chemistry. Box 505, Washington, D. C. Monthly. 75c a copy, $7.50 a year. A technical journal which contains much material which teachers can use.

National Geographic Magazine. Washington, D. C. Monthly. 50c a copy, $4.50 a year. Best monthly journal for high grade pictures. Articles are of interest to general reader, pupils and teachers, as well as to geographers.

Nature Study Review. Ithaca, N. Y. Monthly. 20c a copy, $1.50 a year. An illustrated journal for teachers of nature study.

Popular Mechanics Magazine. Chicago. Monthly. 25c a copy, $3.00 a year. Short science items and articles well illustrated. Appeals strongly to elementary pupils. Suggest many construction projects.

Popular Science Monthly. 255 West 39th St. N. Y. C. Monthly. $3.00 a year, 25c a copy. A Review in text and pictures of the news of science and invention presented in a humanistic and inspirational way. Used as a supplement to text-books in many high schools. Valuable to science pupils and teachers.

Review of Reviews. 30 Irving Place, N. Y., N. Y. Monthly. 35c a copy, $4.00 a year. An illustrated monthly covering world affairs. Contains many good articles bearing on science, suitable for class reports.

Safety Engineering. 80 Maiden Lane, New York. Monthly. $3.00 a year. 25c a copy. A journal devoted to conservation of life and property and contains much material helpful in science classes.

School Science and Mathematics. Chicago. Monthly. $2.50 a year. A teacher's journal. Includes many helpful suggestions.

Scientific American. Woolworth Building, N. Y. Monthly. 35c a copy, $4.00 a year. Has longer articles than the other popular science journals. Illustrated and is particularly valuable to high school science pupils and teachers.

Science and Invention. 233 Fulton Street, N. Y. Monthly. 25c per copy, $3.00 a year. Ill. Popular articles on astronomy, physics, photography, radio-activity, medicine, and in fact, science in general.

Scientific Monthly. Garrison, N. Y. 30c a copy, $3.00 a year. Articles as a rule are more along lines of pure science. Much of value to teachers. Articles can be read to advantage by many pupils.

Transactions of the Illuminating Engineering Society. 29 W. 39th St. N. Y. Monthly. 75c a copy, $5.00 a year. Technical. Many articles contain material which can be used in high school classes.

Woman's Home Companion. 381 Fourth Ave., N. Y. C. Monthly. $2.00 a year. Good articles on foods and homes.